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Diversity of Material Properties in Low Dimensional Hybrid Halide Materials

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3-dimensional hybrid halide perovskites have been intensely researched because of their extraordinary optoelectronic properties with spectacular quantum efficiencies arising primarily from their suitable bandgaps to harvest the solar spectrum, low excitonic binding energies, and low-cost synthetic processes. However, stabilizing these materials under real-life operating conditions has proven to be a challenge, leading to extensive explorations of lower dimensional analogous hybrid halide materials that are often more stable, though, in general, having considerably higher bandgaps and excitonic binding energies. A wide variety of properties have been discovered in this class of materials, revealing many fundamental aspects of these unique systems. I shall present some of our investigations leading to the synthesis of interesting 2-dimensional hybrid halide materials with exciting properties, such as a 2-D hybrid lead halide compound with the lowest bandgap and excitonic binding energy[1] and another class of quasi 2-D hybrid copper halide compounds with interesting chiro-optical properties[2] coupled with ferroelectricity.

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Microbial solutions to tackle energy crisis and climate change

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Addressing the global challenge of sustainability calls for cost-effective and eco-friendly pathways to go beyond the existing energy-intense synthetic routes. Biohybrid (photo)electrochemical systems can synergistically combine the strengths of biocatalysts and synthetic electrodes/photocatalysts to leverage the power of intercellular metabolism for energy conversion and chemical synthesis using (photo)electrochemistry. 1 Of particular interest are “electric microbes” with the naturally evolved ability to electrically interact with insoluble metal oxides for anaerobic respiration, which promises broad applications in microbial fuel cells, microbial electrosynthesis, and semiartificial photosynthesis. Microbes are extraordinary chemists. In the past decade, my research has focused on “electric microbes” and their practical applications in bioenergy and chemical synthesis. 2,3 Electric microbes evacuate their metabolically generated electrons to surfaces outside the cells, a process called extracellular electron transport (EET). It is also possible to reverse the EET by injecting electricity into microbes (electricity-eating microbes) that convert carbon dioxide to solar fuels and chemicals (semi-artificial photosynthesis), and it exceeds the efficiency of natural photosynthesis. 4 A primary emphasis of my research is to hack this unique “electric metabolism” to produce electricity and fuels/chemicals from waste carbon. I investigate fascinating chemistry occurring within bio-material interfaces and natural electron/energy transfer processes. My research discovers and

implements the chemistry and biology necessary to transition to a sustainable energy-based society (net zero targets). I employ an interdisciplinary research approach (biology, chemistry, and physics) to understand electric metabolism, including electrochemistry (voltammetry and amperometry), advanced microscopy (SEM, TEM, AFM), spectroscopy (NMR, Raman, IR), chemical imaging (TOF-SIMS, nanoSIMS) and molecular biology techniques (genomics and proteomics). This presentation will give an overview of my recent research progress on microbial electricity production from waste including plastics, microbial cell factories to synthesize electrocatalysts and constructing prototype living photobiohybrids (artificial photosynthesis) for the conversion of carbon dioxide to solar fuels and chemicals.

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Nanotechnology in Drug Delivery

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In July 2010, the government of Malaysia introduced the National Nanotechnology statement in which it aspires to exploit nanotechnology as an enabling engine for new economic growth, sustainable development and societal well-being. Research and innovation into this new technology were very much underway since then led by local universities and research institutes. Collaboration with industry players and international counterparts are very much alive. After nearly two decades, The National Nano Technology and Products Roadmap was launched to support the National Nanotechnology Policy and Strategy 2021-2030 in the quest to fuel a more vibrant nano industry in the country. This roadmap is to realise products from nanotechnology research and innovation that can be commercialised. One of the uses of nanotechnology identified is its use in drug delivery. Research has shown that biodegradable materials namely the natural polymers, lipids and metals can be used to develop drug delivery at the nanoscale. Active pharmaceutical ingredients (APIs) can be integrated into the system or attached to the particle surface which has been very much reduced in size. Amongst the importance of nanosizing particles are that the dissolution, absorption and permeation rate of drugs can be enhanced due to the increase surface area to volume ratios of the nanosystems. Various nanosystems have been created for drug delivery such as nanosuspensions, solid-lipid nanoparticles, nanoemulsions, polymeric nanoparticles, nanotubes and nanowires and even cellular backpacks. Some of the systems are in use while others are in further development. The potential of applying nanotechnology in pharmaceutical development and drug delivery is enormous. Nanotechnology development initiatives provide platforms for science and engineering research, in order to create innovative and marketable products and services.

INDIGENOUS INSTRUMENTATION AND COMPUTATIONAL PACKAGES FOR CUTTING-EDGE RESEARCH

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To take research in India to the cutting-edge, we would ideally want our own base of instrumentation. But is this practical? I will take the audience through a fascinating journey which saw my team developing Scanning Probe Microscopes, Physical Properties Measurement Systems and Chemical Vapor Deposition Systems all the way out to internationally competitive standards. I will then describe how we have gone about enhancing the base so developed for research in material science, condensed matter physics and nano-technology, with packages for scientific computation, including a world-class solver for the Boltzmann equation designed and developed essentially from scratch. The talk will inevitably provide a host of insights into the much-discussed academia-industry link, on which the approach is largely based.

ABOUT THE SPEAKER

Dr. Sahdev trained, as a particle theorist, in leading groups at Cornell University, Univ. of Pennsylvania, and the International Center for Theoretical Physics (Italy) among others. While at these centers, he worked and interacted with several Nobel laureates including Prof Salam, Ken Wilson, Steven Weinberg and Richard Feynman.

He then joined IIT Kanpur, where over two decades of innovative teaching, he turned out some of the best physicists of the country. Many of his students have, by now, received the Bhatnagar, Infosys and other prizes.

Prof. Sahdev has contributed to several branches of physics: He was a co-discoverer of radiation zeroes and of their use in determining the anomalous magnetic moment of the W-boson. He is one of the original pioneers of the field of higher-dimensional cosmologies. He has worked on the non-linear dynamics of Josephson-Junction arrays and has developed several algorithms for simulating them.

Furthermore, he has made considerable progress in achieving the integration of theory, computation, experiment and instrumentation at QuazarTech a Research Lab, Educational Center and Company, all merged into a single entity which he set up. In particular, he and his group have developed several Scanning Probe Microscopes, Physical Properties Measurement, Chemical Vapor Deposition and Data-acquisition Systems, and used them not only for their own research and teaching, but also to facilitate teaching and research across the entire country.

Prof Sahdev is currently part of the Expert Advisory Group of the Instrumentation/Device Development Program of the Department of Science. and a Former Member of the Technology Development Board of the Government of India.

Nanomaterials for Sustainable Agro-Food Systems

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Nanomaterials found broad applicability in agriculture & protection and post-harvesting, such as plant regulation, seed germination, and genetic manipulation. Their size, surface morphology, properties, and composition were designed for controlled release and enhanced properties in agriculture and the food industry. Nanoparticles can potentially be applied for the targeted and controlled delivery of fertilizers, pesticides, herbicides, plant growth regulators, etc. This help to eliminate the use of chemical-based pesticides and their water solubility, protect agrochemicals from breakdown and degradation, improve soil health, and naturally control crop pathogens, weeds, and insects, ultimately leading to enhanced crop growth and production capacity in the food industry. They can be effectively utilized for nano-encapsulation, seed germination, genetic manipulation, etc., for protecting plants and improving crop productivity, safe and improved food quality, and monitoring climate conditions. Nanoparticles played a crucial role in the uptake and translocation processes, genetically modifying the crops, high seed germination, and productivity.

Green nanotechnology for devices

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The role of nanoparticles in improving the quality of life is known to all. Indeed, nanotechnology has entered each and every sphere of our lives, be it healthcare, medicine, cosmetics, food, prosthetics, household goods, material, etc. In fact, there is hardly any aspect of life which remains untouched by this science. The extent to which nanotechnology has entered our lives depicts the utility and the importance of size reduction of material. It is rightly said that "good things come in small packages" and what better example than the naturally occurring seeds. Every seed has the potential to unleash a new life! This is what drives scientists across the world in pursuit of materials with newer capabilities and nantechnology plays a major part in this enhancement of properties of the material. In this talk, the role of additive engineering to enhance the properties of flexible material shall be discussed. Flexible material is the current generation material for devices and electronic systems. Enhancing and modulating the properties of these material alongwith retaining their flexibility has always been a challenge. Additionally, their disposal also needs to be addressed. In this talk, focus will also be on to reduce pollution and negative impact on the environment. The talk will show some results of our group towards achieving the same.

Nanofluids for ultrafast cooling of steel

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Nanofluids are stable suspensions displaying enhanced heat transfer capability with fractional addition of nanoparticle. They can be prepared via single-step or two-step methods, using nanoparticles synthesized through co-precipitation, sol-gel, wet chemical method, etc. Their improved thermo-physical properties and stability indicate better heat transfer capability even after prolonged storage. Need for Nanofluid arises owing to water's low thermo-physical properties, limiting its high cooling ability. With water coolant on the run-out table (ROT) section of the hot rolling mill, in a Steel plant, the laminar jet barely reaches a 30-80 ^{o}C/s cooling rate, which is unsuitable for property enhancement through desired microstructure formation. The economical alternative over expensive alloying element inclusion, at the casting stage, is ultrafast cooling (UFC), achievable using forced

jet/pressurized spray/air-atomized spray and suitable coolants. By employing UFC, the cooling rate for a 6 mm thick steel plate has reached more than 200 o C/s in our Laboratory experiment. The cooling experiments are performed at optimized conditions by recording transient temperature data from embedded thermocouples, that is used later to calculate surface temperature, cooling rate, surface heat flux and heat transfer coefficient via inverse heat conduction analysis. Different nanofluids used in our experiments to improve cooling performance are $Cu/Al_2O_3/TiO_2$/Cu-Zn-Al LDH/SiO_2 in single or mixed configuration with and without surfactant. These works have given a new solution in industrial cooling application, particularly in the area of ultrafast cooling.

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Synthesis of Hydrophilic $YVO_4:Tm^{3+}$ Nanophosphor and its Optical Characterization

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KEYWORDS: Nanostructures; Optical properties; Luminescence; Hydrophilic; Emission.

This project documents the optical characteristics of hydrophilic-nanocrystalline Thulium doped Yttrium Orthovanadate (YVO_4: Tm^{3+}) nanophosphor synthesised by the Solid-state reaction – Sol gel method. The prepared nanophosphor was characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), absorption spectroscopy, Fourier transform infrared spectroscopy (FT-IR), UV-Visible Spectroscopy and PL. The results of XRD and TEM show that, high-quality nanophosphors with controlled morphology and crystalline microstructures were synthesised at a relatively low temperature about 300 ^oC, 500 ^oC, & 700 ^oC. The particle's crystalline size ranged from 2 nm to 50 nm, with an average particle size of 4 nm, according to TEM images. Upon ultraviolet excitation, the vanadate host transferred energy to thulium ions efficiently and strong blue emission (440 nm - 476 nm) assigned to $^1G_4$ - $^3H_6$ transmittance is observed and reported. The PL emission $^1D_2 \rightarrow {}^3F_4$ with the peak centered at $\lambda \approx 445$ nm corresponded to the characteristic's emissions of Tm^{3+} ions. By analyzing excitation and emission spectra of YVO_4: Tm^{3+} i.e., thulium doped yttrium orthovanadate, it can be deduced that the emissions are excitation independent emissions. Mechanism of the energy transfer between vanadate host material and dopant thulium ions were also studied.

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Energy Absorption Characteristics of Thin-Walled Mild Steel Tubes of Different Cross-Sections Subjected to Axial and oblique Impact Loading

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Thin-walled mild steel (MS) tubes are generally employed as a crash-box in transport vehicles to mitigate the structural damage, human injuries, and deaths during an accident. These tubes are located in between the bumper and front side rail. They convert kinetic energy of an external impact in to plastic strain energy by undergoing a stable progressive collapse during crushing event. Thus, they reduce forces and jerks transmitted to the occupants. Therefore, these thin-walled collapsible energy absorbers are usually classified as a passive safety device in an automobile. In this numerical study, crush behavior of the thin-walled tubular structure having the same mass but having different cross-sectional profiles like square, rectangular and hexagonal (Fig. 1) is studied under axial and oblique impact loading. This study is carried out by using commercially available non-linear FE analysis code ABAQUS/Explicit. Out of various crashworthiness performance indicators, energy absorption (EA) and crush force efficiency (CFE) are considered as predominant performance criteria. It was observed that, EA and CFE changes with the change in the cross-sectional profile of the tube. Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) which is a multi-criteria decision making (MCDM) technique is used to select the cross section having the better crashworthiness performance. It was concluded for this study that hexagonal crash-box is better than other two considered crash-boxes in terms of crashworthiness behaviour.

A DFT studies of glucose on metal doped graphene as a Biosensor

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Diabetes mellitus is a disorder that responds normally to insulin and leads to disease-causing blood sugar levels to be abnormally high. The glucose molecule a form of sugar is an energetic analyst involved in a major catabolic pathway. Several lives threatening, and lives impeding situations greatly affect the diabetic community, resulting in a higher risk of cardiac, nervous, renal, ocular, cerebral, and peripheral vascular diseases. Hence, blood glucose monitoring is a significant tool in the diagnosis of diabetes. Around 85% of the biosensor industry works on glucose sensors and therefore, it has been an extremely energetic area of sensor research. The progress of non-enzymatic glucose (direct) sensors has grown at a significant rate over the past decade. The introduction of nanomaterials has improved sensor application due to higher surface area, enhanced glucose oxidation kinetics, and selectivity. To understand the fundamental mechanism and its relationship with the graphene-based electrode, there is a need for effective research using both theoretical and experimental approaches. Graphene-based sensors are improved by altering with transition metal and can act as a noble material for fast and accurate measuring of blood glucose. Graphene has a zero-band gap structure and transition metals possess free electrons at the d-orbital. Therefore, the arrangement of graphene and transition metal is distinctive and also enhances the sensitivity due to the high surface area of

graphene. Graphene acts as a promising material for biosensor applications due to its large surface area, electronic, and electrochemical properties. Although large number of experimental works were investigated based on graphene as a glucose sensor, however a few works have been studied by using DFT method. With the simulation approach it is evident to check the possibilities of direct glucose (β - D glucose) sensing by the graphene doped with metal atoms. The synergistic effect of metal/graphene composites has proved to possess outstanding electrochemical, electrical, and optical properties which were superior compared to individual elements. The adsorption of glucose is theoretically examined using the Density Functional Theory method (DFT) over pure graphene and graphene surface doped with transition metal atoms (silver, gold, copper, nickel, and platinum). The graphene sheets are altered by substitutional doping of silver, gold, copper, nickel, and platinum atoms remarks in altering the electronic properties and actively reassuring glucose absorption. The outcomes revealed that metal atoms doped with graphene sheets improve the reactivity. Our study found that the interaction of glucose with pure graphene is weak when compared to metal-doped graphene flakes. Our studies concluded that due to strong adsorption energies, high bandgap variation, and excellent work function values of metal-doped graphene sheets make them beneficial for glucose sensing devices. The sensitivity and conductivity variations are high for the metal doped graphene sheets except nickel; however the recovery time value is high, suggesting that these sheets can be used as a disposable sensor.

INFLUENCE OF AMPHIPHILIC POLYMERS ON PHASE SEPARATING BINARY MIXTURE: A DISSIPATIVE PARTICLE DYNAMICS STUDY

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We present DPD simulation (Groot and Madden, 1998; Groot and Warren, 1997; Singh et al., 2018) results to manifest the influence of amphiphilic polymers (APs) on the evolution morphologies, dynamic scaling functions, and length scale of binary (AB) simple fluid (SF).(Bray, 1994; Singh and Puri, 2015) The segregation of APs at SF interfaces is discussed as well. The results are discussed for three distinct AP topologies such as block copolymer (BCP), ring block copolymer (RCP), and miktoarmstar polymer (MSP). After the quench into an unstable coexistence region, we observe significantly different SF evolution morphologies in various APs presence, hence, the deviation from the dynamical scaling. The extent of interface roughness of SF morphology is well established by the fractal dimension obtained from the non-Porod structure factor tail. Typically, the characteristic length scale for SF follows a power-law behavior: $R(t) \sim t^{\phi}$, where ϕ is the growth exponent.(Singh et al., 2015, 2018; Singh and Puri, 2015) We observed diffusive growth, $\phi \sim 1/3$, at early times followed by saturation in length, $\phi \sim 0$, at late times in a high AP presence. The extent of saturation varies with constrained imposed over APs, such as topology, composition ratio, chain length, and stiffness. At lower composition ratios, the system tends to inertial hydrodynamic growth, $\phi \sim 2/3$, at the asymptotic times without entirely getting into viscous hydrodynamic regimes, $\phi \sim 1$, earlier at the time scale of our simulation. Overall, our results firmly establish the existence of hydrodynamic growth regimes in low surfactant-influenced phase separation kinetics of binary fluid and firmly settle the related ambiguity in d=3 systems.

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Formulation and in-vitro Evaluation of Electrospun Nanofibers for Enhanced Solubility of Olmesartan Medoxomil

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Olmesartan medoxomil (OLM), which is a Biopharmaceutical Classification System (BCS) class II drug has low aqueous solubility, resulting in its poor bioavailability and therapeutic efficacy [1]. In this resent study, OLM was formulated into electrospun nanofibers in order to enhance its aqueous solubility and dissolution rate. OLM loaded nanofibers were formulated by using electrospinning method using Eudragit RS 100 and Soluplus as carriers [2,3]. The physicochemical characteristics of nanofibers were evaluated by SEM, FTIR, DSC, drug content uniformity and in vitro dissolution studies. SEM and DSC analysis suggested that the electrospun nanofibers were uniform and OLM is dispersed in an amorphous state. FTIR analysis showed no incompatibility between drug and polymers in the nanofiber. OLM content in the prepared OLM loaded nanofibers with Eudragit RS 100 and Soluplus were found to be 96.93 ± 0.03% and 93.67 ± 0.05% respectively. In vitro dissolution concluded that Soluplus and Eudragit RS 100 increased OLM's dissolution rate by 3-fold and 2-fold respectively. In conclusion, OLM had good compatibility with both the carriers and OLM's dissolution rate was remarkably enhanced by formulating electrospun nanofiber with Eudragit RS 100 and Soluplus.

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Synthesis and Characterization of Nanostructured Cuprous Oxide (Cu_2O) Absorber Layer for Photovoltaic Application

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The Cu_2O thin film was deposited onto FTO (Fluorine-doped Tin Oxide) glass substrate through electrode position technique. The solution was prepared with constant molar concentration and the value of pH was adjusted to 9.5 for all cases. The optical properties of the films were studied with the help of UV-Vis Spectroscopy. This study revealed that the better performance for the electrodeposited Cu_2O thin film was found for the sample with the applied voltage (-1.5V) and 40 minutes of deposition time. The optical band gap was found to be 2.18 eV for this sample. The maximum absorbance of Cu_2O thin film was 17.20 (au) at applied voltage (-0.95V) and the minimum absorbance was 10.90 (au) at applied voltage (-0.97V). The maximum absorption coefficient was found to be 11.5 103 cm-1, at 80 minutes of deposition time and the maximum absorption coefficient was 21.00 103 cm-1, at applied voltage -0.95V. The Urbach energy and the minimum steepness parameter at 5 minutes of deposition time were 2.00 eV and 0.013 respectively. The minimum Urbach energy and the maximum steepness parameter at (0.93V) of applied voltage were 0.34 and 0.076 respectively. The refractive index increases gradually with the increase of applied voltage and the maximum refractive index was obtained at applied voltage -1.5V. The structural properties of Cu2O thin films prepared at different applied voltage were investigated by X-ray diffraction (XRD) and the surface morphology was investigated by Scanning Electron Microscopy (SEM) respectively. Nano scale grain size was obtained from the SEM images and our purpose to fabricate the nanostructured thin film was fulfilled. This research described the optical, structural and morphological properties of Cu_2O thin films with varying applied voltage and deposition time and studied development of the Cu_2O thin film to improve the efficiency.

Green production and analysis of silver nanoparticles utilizing Pathor Kuchi Leaf

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Silver nanoparticles (Ag NPs) were manufactured utilizing Pathor Kuchi Leaf (PKL) extract in an environmentally, cost-effective green way. X-Ray Powder Diffraction (XRD), Fourier Transform Infrared (FTIR), Ultraviolet–Visible Spectroscopy (UV-vis), and Scanning Electron Microscopy (SEM) have been used to look into Ag NPs generation. The crystalline structure was shown by the

XRD pattern investigation, and its typical size is 19 nm. Its biological molecules composites are in charge of the diminish and also capping of Ag NPs, according to FTIR spectra. The UV-vis spectra of Silver NPs expressed a noticeably large absorption peak centered at approximately 400 nanometers, which denoted the production of Ag^0 from Ag^+. After the distribution of sizes analysis, it must have been discovered that the mean dimension of the particles of the spherical silver nanoparticles in the SEM pictures was 5.33 μm. Ag NPs have been shown to potentially improve the power generation, short circuit current, and open circuit voltage of PKL bio-electrochemical cells. This work exhibits the straightforward, economical, and ecologically friendly way of their manufacturing. The uniqueness of this work is the first-ever comparative analysis and Ag NPs production utilizing PKL extract. The majority of the conclusions have been grouped and visually explained.

The fundamental of ferroic-photocatalysis and its application

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Photocatalysis involving ferroic materials is emerging as an effective strategy to addressing the energy and environmental issues. The rich domain structures and built-in electric field are unique merits to counter the recombination loss of photogenerated charge carriers. Despite some initial exciting reports, only limited attempts have been made towards understanding the underlying physico-chemistry of the ferroic-photocatalysis. In this talk, we provide a fundamental overview to bridge ferroelectric physics and photocatalytic chemistry by introducing the built-in electric field, anomalous photovoltaic effect, polar nano regions and surface active sites, etc. Our objective is to stress the importance of the underlying dynamics at play in ferroic-photocatalysis and advance its application in guiding materials design toward better life.

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Ultralightweight Graphitic Sheet-Based Carbon Aerogels

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3D interconnected carbon aerogels have emerged as a new class of highly porous and ultra-lightweight materials exhibiting exceptional structural, electrical, electronic, and electrochemical properties offering a broad scope for applications such as energy storage, catalysis, water desalination/filtration and more. However, the present methods of synthesizing these materials are complicated and non-sustainable. We have developed a scalable and green approach to synthesizing a uniquely structured 3D hierarchical carbon aerogel composed of graphitic sheets stretched across an underlying carbon fiber network. We have established insights into the surface structure and chemistry of the developed material and how it depends on the process conditions, such as temperature, time, and the precursor. We have performed structural and chemical analyses of the developed material and explored it for energy storage and water desalination/purification applications. Specifically, our studies have shown this material's ability to remove 99.99% of nano/microplastic contamination and reduce ionic levels by over 98% in seawater using gravity-based filtration, making it promising for water filtration/desalination applications.

Application of nanotherapeutics for the disruption of biofilm of *Klebsiella pneumoniae* and *Enterococcus faecalis*

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Background: Multidrug resistance (MDR) in gram-negative *Klebsiella pneumoniae* and gram-positive *Enterococcus faecalis* is becoming a significant health challenge that is progressively increasing worldwide. These bacteria are important opportunistic pathogen that commonly causes antibiotic-resistant infections in hospitalized patients. One of the important resistance mechanisms that bacteria develop against several antibiotics is biofilm formation. Nanoparticles may play an important role in the coating of medical devices and treatment of infection caused by biofilm-forming pathogens It maintains the drug from being degraded by bacterial enzymes. Studies exhibited that silver nanoparticles (AgNPs) are one of the most effective antimicrobial activities against various clinically important MDR pathogens. Yet, there are many nanoparticles undiscovered and their use in clinical practice is limited, more research is required to understand their mechanism, toxicity, and their effect on human beings.

Objective: This study is aimed to apply a novel nanoparticle silver with mesoporous silica against these biofilm-forming bacteria to study its efficacy in eradicating biofilm formation.

Material and method: *K. pneumonia* and *E. faecalis* (ATCC 29212) were cultured in Tryptic Soy Broth (TSB), Nutrient Broth (NB), and Mueller Hinton Aga media by using 96 wells plates with two different sets of novel nanoparticles. Drug efficacy was tested by serial dilution technique to

determine the minimum inhibitory concentration (MIC). Then each set of serially diluted nanoparticles was cultured in MHA and incubated at 37 °C for 24 h.

Results and discussion: The results showed that biofilm forming *k. pneumonia* and *E. faecalis* showed significant inhibition when treated with two novel nanoparticles. The minimum bactericidal activity (MBC) for *E. faecalis* was the highest concentration of 8mg /1ml. The MIC was 8mg/ml and 1mg/ml for *k. pneumoniae* and *E. faecalis* respectively. For both bacteria, nanomaterial showed efficacy at a higher concentration of 8mg / 1ml. We obtain significant results from the light microscope when compared with the control which showed less aggregation around the nanoparticles.

Conclusion: The finding suggested that the synthesized nanomaterial has a potential antibiofilm activity and the ability to eliminate bacterial biofilm. Future investigations are necessary to validate these nanoparticles as a promising aspect to treat the infection of MDR bacteria.

Mitochondrial membrane depolarization and ROS generation by functionalized copper oxide nanoparticles with polylactic acid in breast cancer cells

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Nanotechnology is an emerging field of science and technology at the nanoscale level. The current study focused on synthesizing copper oxide nanoparticles (CuONPs) from the bacterial cell-free extract. These copper oxides were further conjugated with polylactic acid. The conjugated CuONPs (cCuONPs) were characterized by UV-Vis spectrophotometry, FTIR, TGA, SEM, EDX and TEM.TEM analysis showed the particles are spherical and in the size range 20 – 35 nm. These cCuONPs showed excellent antibacterial effects against various bacterial pathogens. Furthermore, cCuONPs exhibit remarkable toxicity towards MDA-MB-231 cells while less toxic towards normal 3T3 cells through MTT assay. Apoptosis study reveals membrane blebbing and chromatin condensation. cCuONPs showed an excellent release of ROS and arrested the cell cycle at the G2/M phase. cCuONPs showed mitochondrial membrane depolarisation (Δψm) with 43.61% and extensive DNA damage on agarose gel electrophoresis. Therefore, these cCuONPs could become the potential anticancer agent for drug delivery to treat breast cancer and in pharmaceutical and biomedicine applications.

Co-encapsulation of multivitamins in micro and nano-sized starch, target release, capsule characterization and interaction studies

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This study was carried out to protect the vital vitamins like D, E, B1 and B2 via encapsulation in micro and nanoparticles of starch from water chestnut. The encapsulation efficiency, particle size, thermal properties and molecular configuration & interactions were studied. The encapsulation efficiencies of nano-sized starch (365nm) was higher than micro sized starch (3.67µm) for vitamin D, E, B 1 and B 2, which was found to be 35%, 81.17%, 83.13%, 76.07% and 46.27%, 89.29%, 84.91%, 77.60% respectively. Fluorescence showed higher intensity and non-covalent interactions within the

internal matrix of capsules. The FTIR peak at 877cm^{-1} belonging to vitamin ring structures was prominent and confirmed the presence of vitamins in encapsulated powders. The nano starch capsules showed better thermal stability and low crystallinity than micro starch capsules of vitamins. The study suggests the use of co-encapsulated vitamins in food fortification/supplementation to overcome the issues related to vitamin deficiencies.

Minimalist Peptide Nanotechnology for Applications in Healthcare

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Self-assembly of biomolecules to form hierarchical supramolecular ordered structures is emerging as a promising area for fabrication of highly functional smart biomaterials. Peptide based self- assembled structures i.e. molecular hydrogels have gained tremendous interest due to their unique physicochemical properties emergent at nanoscale, which can find important biomedical applications. In our work, we aim to develop the novel biomimetic functional scaffold using self-assembling bioactive peptide sequences for designing an extracellular matrix (ECM) mimic for tissue engineering applications. We used a minimalistic approach which involves the synthesis of short peptide sequences derived from the natural proteins, both from structural and functional proteins of ECM, like, laminin, Tenascin C, N-Cadherin and collagen etc.. In particular, we have explored the library of structurally related pentapeptides derived from a natural extracellular matrix protein, Laminin, which plays crucial roles in cell adhesion, migration and proliferation. We demonstrated the non-traditional solvent mediated approach to induce supramolecular gelation and access diverse nanostructures. To construct a better mimic of natural ECM, we developed the conjugate gels from collagen and laminin mimetic peptides. The conjugate matrix offers an advantage of incorporating the properties of both structural as well as functional peptide segment of natural ECM. We have also rationally designed two collagen inspired peptides with the oppositely charged amino acids such as lysine and aspartic acid, which can offer specific sites for salt bridge interactions to induce the self-assembly within these peptides. Such coulombic interactions further trigger the formation of the self-assembled hydrogels at physiological conditions. Our other attempts to construct an advanced neural ECM mimics involved the exploration of Tenascin C protein as well as N-Cadherin. Further, we studied differential interaction of cells with variably modified peptide gels. The studies revealed the necessity of proper hydrophobic-hydrophilic balance of a molecule for preferred bioactivity. Further, to attain diversity within single gelator domain, we employed a simple and unique approach of exploring metal ion interactions to provide a convenient means to access diverse gels from single precursors, with reduced defects and enhanced complexity. Another simpler approach was focused on applying a heat/cool cycle over sonication to induce differential gelation behavior in a single gelator template. These different pathways lead to either kinetically trapped or thermodynamically favoured states giving rise to diverse hydrogels. The gels were found to be thermoreversible and self-healing which induces the injectable behavior in these designer gels. The resulting new materials are further modified with specific carbohydrate moieties, such as, cellulose as well as other glycosaminoglycans, like heparin to create peptide-polysaccharide conjugates. We anticipate that our approach of combining peptides and sugars will result in creation of self-assembled nanomaterials which will be capable to foster the chemical and mechanical needs to be a superior surrogate of natural ECM. Ongoing studies are focusing on the futuristic application of these biomolecular gels of variable stiffness towards controlling stem cell differentiation.

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ORGANIC FRAMEWORK NANO-RESERVOIRS

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Keywords: Covalent organic frameworks, Biomacromolecules, RNA, Storage

Room temperature storage of biomacromolecules such as Ribonucleic acid (RNA), Deoxyribonucleic acid (DNA) and proteins have emerged as an interesting challenge. Recent studies show that ionic liquids (ILs) can act as an efficient solvent for storing various enzymes, biopolymers and proteins.[1,2] However, ILs are generally toxic, and the high vapor pressure of ILs makes recovery of biomacromolecules from a solution of ILs cumbersome. A more appropriate platform for storing these biomolecules would be inside ionic porous solid materials. In my talk, I will discuss one of our recent works on ionic organic framework-based nano-reservoirs for biomacromolecules storage.[3] Initial results show that encapsulated biomacromolecules are stabilized inside the nano-reservoir via a favorable electrostatic interaction, confirmed by DFT energy analysis.

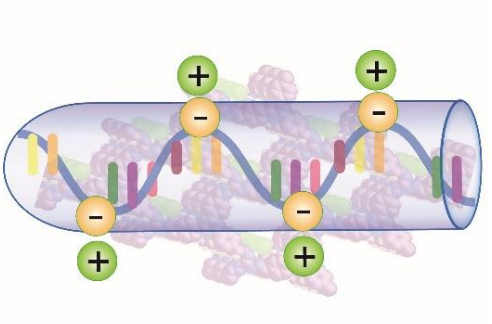

Fig. 1: Biomolecule storage in organic framework.

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FORMATION OF SELF-ORGANIZED NANO-DIMENSIONAL STRUCTURES ON INP SURFACES USING ION IRRADIATION AND THEIR WETTABILITY

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Implantation of various surfaces with ion beams is one of the important tools for the fabrication of different kinds of self-organized nanopatterns on diverse substrate surfaces [1-2]. Beam parameters like ion energy, ion fluence and angle of incidence etcetera play a significant role in deciding the shape and size of the surface nano pattern (ripple or dots) [2-4]. These patterns have many practical applications. InP samples have been irradiated with 50 keV Ar^+ ion beam at various ion fluence ranging from 2×10^{16} to 8×10^{16} ions/cm^2. The experiment was carried out in 90-degree beamline of Low Energy Ion Beam (LEIB) Facility, dedicated to Materials Science, in IUAC, New Delhi. Nuclear (S_n) and Electronic (S_e) energy losses of 50 keV Ar^+ ions inside InP were calculated as 50.5 eV/Å and 19.7 eV/Å using SRIM software. The range of the Ar^+ ions inside InP is approximately 46.5 nm. The pristine and irradiated samples were characterized with AFM and contact angle measurement set-up. We observed the formation of regular nanodots on the surface of InP upon irradiation with Ar^+ ion beams. The distribution of size of dots is improved with ion fluence. The size of the dots varies from 70 nm to 90 nm. Due to an interplay between the roughening induced due to sputtering and surface diffusion, there is a reorganization of mass occurs on the surface and thus, results in the formation of various surface pattern as a result of ion irradiation. RMS surface roughness increases from 0.4 nm to 10.3 nm with ion fluence and the surface becomes hydrophobic in nature at lower fluences. The nano-dimensional dots formation evolves with ion bombardment on InP surface. Wetting nature of any solid surface can be tuned by optimizing the ion beam values in a desired way.

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A big jump from Japan to IIT Delhi in the wake of Covid-19: Higher education, student culture, atomic and molecular physics, and life in general

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Two years have passed since I joined the physics department of IIT Delhi after my academic career in Japan and in the United States. I am grateful that I managed to start well in India despite the pandemic with the kind support of my new colleagues and the rewarding experience of engaging with eager Indian students. I was very impressed by the competitive and strongly focused students of IIT. Particularly their superb mathematical dexterity gives them a great advantage to pursue any field of science. However, their very strong focus on marks and grades continuing all the way up to graduate school seems a bit extreme and perhaps not all is well about that. The multi-track education system involving B.Tech., B.Sc., M.Sc., M. Tech, PhD, and dual degrees together with all the national standardized entrance examinations are difficult to understand for any foreigner. They also seem to brew exotic student cultures. Internationalization seems to be a difficult issue despite India itself being extremely diverse internally. The inclusion of women and different social classes seems to have issues characteristic of India, even though progress has been made. My own field, atomic and molecular physics is an area in which India has a strong tradition. I hope it is not being somewhat weakened by the stronger emphasis on applied research. The above issues and more will be discussed as they relate to my own first-hand experience. Comparisons will be made to Japan and America. Comparative education in higher education has not been nearly as well studied as in lower levels. So, I would like to hope my observation and thoughts as an amateur can nevertheless be useful.

Valorization of Carbon Dioxide for making Biodegradable Polymers and Post Polymerization Functionalisation for Desired Applications

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Utilization of CO_2 had witnessed intense research activity from scientific community mainly due to climate change considerations. In our laboratory we have a long-term interest in using CO_2 as C1 feedstock during the catalytic coupling of epoxides and CO_2 to achieve polycarbonate polymers. Thus

capturing CO_2 from point sources and further its utilization as a C1 feedstock can result in cheaper and cleaner production processes. Thus, the idea of utilizing CO_2 for creating valuable products might reduce the overall cost for removal of carbon dioxide from the atmosphere. Although tremendous progress has been achieved, the aliphatic characteristics and lack of functionalities of these polymers limit the scope of their application in high value-added and functional materials. Recently we have employed different approaches for introducing functionalization in these polycarbonates which directed their applications in areas such as self-healing materials, polyurethane industry, inks for 3D printing and as conducting polymers.

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ANALYSIS OF *CARD14* GENE SNP IN KASHMIRI PSORIASIS PATIENTS

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Psoriasis is a chronic immune mediated skin disorder. The disease is characterized with overt turnover of keratinocytes due to extensive proliferation and inflammation resulting in red erythematous skin plaques [1]. The disease is known for its wide geographical variations due to genetic susceptibility, immunogenic and some environmental factors. The underlying etiology of psoriasis is still unknown [2]. Multiple psoriasis susceptibility (PSORS) loci have been identified, among them PSORS2 (chromosome17q25) was found to be due to gain-of-function mutations in the CARD14 gene. CARD14 is primarily expressed in keratinocytes and in mucosae. Recent studies have illustrated that this scaffold protein plays a crucial role in the human skin. In normal circumstances CARD14 remains in autoinhibitory mode, once activated by its corresponding signalling molecule it recruits interacting partners BCL10 and MALT1 to form the so called CBM complex which activate the inflammatory transcription factor NF-κB that regulates proinflammatory gene expression [3]. Therefore, it is generally believed that excessive activation of NF-κB in keratinocytes by psoriasis-associated CARD14 variants can initiate an inflammatory reaction that attract immune cells to the skin and culminates in psoriasis development [4]. Number of inflammatory cytokines have been found to be elevated in lesional psoriasis skin, and the serum concentrations of a subset of these also correlate with psoriasis disease severity [5]. It seems reasonable to assume that CARD14 gene mutation activates NFκB, which in turn increases Pro inflammatory cytokines production that culminates in psoriasis development and may act as a risk factor for comorbidities associated with psoriasis also.

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Size-Dependent Nonlinear Dynamic behaviour of a Damped Microplate under Nonuniform Excitation

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A semi-analytical approach is used to present the combined nonlinear vibration and nonlinear response of a damped microplate exposed to different types of in-plane and transverse nonuniform periodic loadings (Fig. 1) to understand the complete nonlinear dynamic behaviour of the plate. The plate is modelled using a modified strain gradient, and third-order shear deformation theories are used to simulate the small-scale effects and shear deformation, respectively. Using Hamilton's principle, the governing partial differential equations of motion are derived and solved using Galerkin's approach. To achieve the nonlinear forced vibration response, the incremental harmonic balance (IHB) is employed in combination with the arc-length continuation approaches. Using the Newmark-β technique, time-history response graphs are generated. The effect of various parameters, such as the different size-dependent theories, damping coefficient, different loading profiles and loading concentrations on the nonlinear dynamic behaviour is investigated. The effect of initial displacements on the steady-state response with respect to the excitation frequency is also demonstrated with the help of a time-history response.

Nano-science and nano-technology in medical science and biology

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Nano-science and nano-technology have introduced some useful unconventional applications in medical science and bioscience. Nano-science has effectively engulfed medical science and

bioscience making a revolution in history of science. Some area will be discussed those have brought revolutions in applications of this modern concept. Some remarkable out comes are

1) Separation of important biomolecules from bio-fluids like interferon from blood, detection of bio markers in bio-fluids for detection of diseases, separation protein and nucleic acid are some of the successful area. All these separation has involved magnetic nanoparticle tagged with appropriate antibody.

2) Faster detections of bacteria and virus have been developed to ease the pathologic hurdles. This is a great breakthrough in field of diagnostics involving of nano-technology.

3) Targeted drug delivery to cancer or some deadly disease was a great dream of Dr Ehlrich and it has been successfully achieved by nanotechnology

4) Detections of location of diseased cells in animal body by MRI and positron annihilation are another miracle in medical science through nanoparticle.

As (III) and As (V) removal through microbial nanotechnology mediated bioaccumulation from contaminated soil and water

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Keywords: Kurthia gibsonii strain MKVVM3 IITBHU, Nanotechnology, Bioremediation, As (III) and As (V), Gene expression.

Nanotechnology has the potential to improve the targeted treatment of hazardous heavy metalloids like arsenic and understanding of the metabolic pathways involved in its bioremediation. Once the arsenic has been bound to the nanomaterials, they can be removed from the environment using various removal techniques, such as adsorption, filtration, and chemical precipitation. These methods can also be used to immobilize arsenic, preventing it from entering the food chain. Additionally, nanotechnology is being used to develop biosensors that can detect arsenic in water and soil. Another important aspect of arsenic bioremediation is the use of genetically modified organisms (GMOs) to break down the arsenic. GMOs can be used to express enzymes that can convert arsenic into a less toxic form, such as arsenite, which is easier to remove. The process of genetically engineering organisms to express arsenic-degrading enzymes is known as “arsenification”. *Kurthia gibsonii* strain MKVVM3 IITBHU was shown to be capable of adsorbing and accumulating including both As (III) and As (V) from the contaminated water. At the genetic level, MKVVM3 IITBHU possessed a variety of genes that encode proteins capable of conferring resistance against arsenic. The metabolic routes of arsenic-containing bacteria can also be investigate using NMR spectroscopy, providing researchers with a deeper comprehension of the pathways of the isolates of how these bacteria utilise their energy. In the SEM study, the can be used to observe nanomaterial and bacteria interaction. AFM analysis revealed that MKVVM3 IITBHU accumulated arsenic in its cell walls, leading to an increase in its surface area in aqueous solutions. Arsenic removal capabilities of MKVVM3 IITBHU were concluded by EDS. Elemental mapping was conducted to infer the presence and distribution of different elements present in the sample. Arsenic elimination is more effective using this nanotechnology-based approach in combination with the *Kurthia gibsonii* MKVVM3 IITBHU. Moreover, it can be used as a catalyst to enhance environmental cleanup, opening the way for safer and more efficient bioremediation methods.

EXPERIMENTAL STUDY OF CEMENT SUPPLEMENTS ON HIGH STRENGTH CONCRETE

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The demand for construction materials rapidly increases due to the infrastructure development all-around the world in past two decades. Particularly the usage of cement as a construction material is higher. However, the production and usage of cement leads to significant environmental impacts. A partial replacement of cement with sustainable waste materials is one of the solutions for reducing the environmental impact. The study aims to evaluate the effects of Rice husk ask, Silica fume and Granite powder on the properties of High strength concrete M80 grade. The study adopts various trial mixes to finalize the mix proportioning of the concrete for achieving required slump as per the mix design. The optimum dosage of superplasticizer has been finalized with help of Marsh cone test. The experimental study has been carried out to analysis the fresh concrete properties such as workability, flowability & resistance to segregation. The hardened properties of concrete have been evaluated through compressive strength, split tensile strength, and flexural strength tests for the maturity of the concrete at the ages of 3, 7, 28 & 90 days. The key findings indicate that the increase in compressive strength, workability and flowability. The study reveals that 20% increase in compressive strength, 26% increase in split tensile strength test, 27 % increase in flexural strength with the controlled concrete. Incorporating the Rice husk ash, silica fume and granite powder will promote the sustainable advancement by mitigating environmental impacts associated with Granite powder and silica fume disposal and decreasing usage of cement reduce CO_2 emission leads to sustainable development in construction industry.

Buckling and Postbuckling Study of Laminated Carbon Nanotube Reinforced Composite Plates

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The buckling and postbuckling study of laminated carbon nanotube (CNT) reinforced composite plate is presented in this paper, using finite element method. The laminated composite plates are composed of perfectly bonded CNT-reinforced layers. The distribution (volume fraction) of single walled carbon nanotube (SWCNTs) is considered uniform throughout the thickness of the plate. The eight-noded degenerated shell element with isoparametric formulation with C 0 continuity (FSDT) of the nodal variables is used to model the plates. The material properties of Carbon Nanotubes Reinforced Composite layer are estimated by extended mixture rule. The linear buckling analysis is performed by solving the eigen-value equation. The postbuckling analysis is carried out by solving the nonlinear load-deformation equation by Crisfield arc-length method. The results obtained from the present formulation are compared with available results to ensure accuracy of the formulation. The Green-Lagrange strain displacement relationship in total Lagrangian coordinate system is adopted in the nonlinear formulation. The effect of different parameters like lamination scheme, number of layers, aspect ratio, and boundary condition, on the buckling and postbuckling response of the plates is considered in the present study. The buckling analysis of a square plate subjected to uniaxial compression taken by Shams and Soltani (2016) is performed, with 8×8 mesh size of the full plate, for

two boundary conditions. The results are presented in Table 1. The present results are matching well with the results of Shams and Soltani (2016).

Table.1. Non-dimensional buckling load of the plate ($\overline{N_{cr}} = N_{cr} * b^2 / E^m * h^3$).

V_{CNT}	Mode	Simply supported		Fixed support	
		Present (8×8)	Shams and Soltani (2016)	Present (8×8)	Shams and Soltani (2016)
0.11	1	31.0557	31.1573	73.4669	73.6066
	2	47.5152	47.9739	87.3278	87.7520
	3	70.3037	70.5572	92.6856	92.3237

All other results will be reported in the full length paper.

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Effect of Crosshead Speed on Fracture Toughness Parameter of Rotational Mouldable Grade Polyethylene

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The application of Rotational Moulding (RM) process is rapidly increasing in plastic processing industries because of its easiness and RM parts are stress free with uniform thickness. This process is widely used for large, hollow plastic products [1-3]. There are four important steps associated with this process: (a) putting the polymer powder in the mould, (2) biaxial rotation of mould with heating, (3) solidification of melted polymer power into the anticipated shape, and (4) take off the final product from the mould. Most widely used polymeric material for RM process is polyethylene (PE) [4].

Polyethylene for rotational moulding is generally characterized by its strength. However, for extending the applications of RM product in load bearing products and various engineering sectors, a thorough understanding of fracture behaviour of PE used for RM process is necessary [5]. Fracture behaviour not only gives idea about crack propagation process but it also tells about the performance of the product in real-world scenario. There are different methods available to evaluate the fracture toughness of the material. The objective of the present study is to investigate the effect of cross head speed on fracture toughness parameter of rotational mouldable grade polyethylene material. To perform fracture tests, a 5mm thick rotationally moulded plate of PE was prepared. Compact tension type of specimens was prepared from the plate. J-integral was considered as fracture toughness parameter. Three different cross head speeds i.e. 1mm/min, 2mm/min & 5mm/min were considered to perform the fracture tests. The fracture test results clearly show the highest fracture toughness value corresponding to 1mm/min crosshead speed and lowest corresponding to 5mm/min. It has been observed that fracture toughness values decrease 6% and 26% at cross head speeds 2mm/min and 5mm/min respectively when compared its value at 1 mm/min. This is indication of ductile mode of fracture at lower displacement rate which changes to brittle mode of fracture at higher displacement rate in case of rotationally moulded polyethylene.

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Developing a Rapid and Sensitive Colorimetric Sensor for Detection of Food Adulterant Rhodamine-B in Real Sample

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The study presented in this work addresses the problem of Rhodamine B (Rh-B) adulteration in food products in developing countries, where this carcinogenic agent is commonly used despite its potential health risks. The authors demonstrate an efficient, easy-to-use, sensitive, and highly selective colorimetric sensing method for detecting Rh-B using Broussonetia Zeylanica (BZ). The authors used FTIR and XPS techniques to identify new surface functional groups and a strong bond between BZ and Rh-B, which enable the colorimetric detection of Rh-B. They observed two strong absorption peaks at 360 nm and 450 nm for BZ-EXT, which disappeared completely in the conjugates. The colorimetric detection was performed in both acidic and alkaline pH, and the practical applicability of the sensor was studied using real samples. The results of the study demonstrate that the developed conjugate has wide applicability for the detection of Rh-B in various real samples. This promising approach for the detection of Rh-B could have significant implications for public health in developing countries where this carcinogenic agent is commonly used as a food adulterant. Overall, this study highlights the importance of developing efficient and sensitive methods for detecting harmful substances in food products to protect public health. The authors approach using BZ as a colorimetric sensor for detecting Rh-B could be extended to the detection of other harmful substances in food products, contributing to the safety and quality of food consumed globally.

Keywords: Rhodamine B; Broussonetia Zeylanica (BZ); Colorimetric Sensors; Detection.

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HYDROTHERMAL ENGINEERED BIOMASS-DERIVED CARBON NANODOTS FOR ANTIOXIDANT AND METAL SENSING ACTIVITY

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Carbon nanodots (CNDs) have the unique optical properties, low cost, eco-friendliness, abundance of functional groups, and high stability. In this study, we have synthesized, characterized, and evaluated carbon nanodots (CNDs) via one step hydrothermal treatment from expired sauce and cow dung as biomass. The synthesized CNDs were characterized by Ultra-violet visible (UV-Vis) spectroscopy, fluorescence spectroscopy, High-Resolution Transmission Electron Microscopy (HRTEM), Selected Area Electron Diffraction (SAED), Energy Dispersive X-ray (EDX), Fourier-transform infrared spectroscopy (FTIR), X-Ray Photoelectron Spectroscopy (XPS) and Thermogravimetric analysis (TGA). The CNDs were evaluated for its metal sensing ability and free radical scavenging. As a result, we have developed environmentally friendly self-passivated CNDs from biomass without the use of any additional passivating agents. The as-synthesized bluish-green fluorescent CNDs showed excellent optical properties with excitation and emission at 357 nm and 432 nm, respectively. The aqueous solubility and thermostability also made them suitable for variety of applications. The FTIR and XPS demonstrated the presence of C-O, C-H, N-H groups. The HRTEM and SAED revealed spherical shaped homogeneous particles with size within 5.14 nm and amorphous properties. Besides having the ability to detect specific ions (Hg 2+ ions), these CNDs also demonstrated inherent antioxidant property against DPPH radical. Overall, these CNDs has wide potential in biological and environmental applications.

Dielectric and Electrocaloric Studies On $Ba_{1-x}Sr_xTiO_3$-$Bi_{0.5}Na_{0.5}TiO_3$-PVDF for Solid State Refrigeration in Room Temperature

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$Ba_{1-x}Sr_xTiO_3$-$Bi_{0.5}Na_{0.5}TiO_3$ Composite were synthesized using Conventional Solid State Reaction method followed by incorporating these fillers into Poly-vinylidene fluoride(PVDF) matrix using Solution Casting Method to fabricate BST-BNT-PVDF composite [1-2]. The structural properties of BST-BNT-PVDF composites have been studied using X-ray diffraction. Microstructure and Particle size of the composites were investigated using FESEM. The frequency dependency of dielectric constant, dielectric losses and AC conductivity of the BST-BNT-PVDF with different filler content in frequency range 20Hz–1MHz with respect to temperature were studied.Ferroelectric properties were examined at different voltages and temperature.Electrocaloric Effect in the as prepared sample were studied using indirect method i.e based on Maxwell equation,in which Measurement of the rate($\delta P / \delta T$)$_E$ is required.

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Elastic Properties and Mechanical behaviour of Two-Dimensional Nanomaterials

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A multiscale model is employed to investigate the elastic properties of graphene and few noncarbon nanosheets with refined empirical bond order Tersoff-Brenner-based potential parameters. The Cauchy-Born rule is used to establish a coupling between the atomistic to continuum scale by expressing the strain energy density function in terms of the total interatomic potential per unit area of the unit cell. The in-plane extensional stiffness, bending stiffness and bending-stretching coupling stiffness matrices are calculated by differentiating the strain energy density function with respect to strain and curvature tensors. The effect of the different stiffness coefficients with finite strain and curvature is studied for graphene sheet with armchair, zigzag and chiral configurations. The results obtained with refined parameters are also compared with the formerly available empirical parameters to investigate the accuracy of the parameters. The set of refined empirical potential parameters is found better for predicting the elastic properties of graphene. A detailed comprehensive study is also reported for comparing the accuracy of the different potential parameters. The free vibration frequencies of the nanosheets and nanotubes are reported and compared with the molecular dynamic (MD) simulation and DFT-based continuum models.

Aptamer selection using gold nanoparticle-assisted SELEX against organophosphorus pesticide

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Recently, the exposure of pesticides to living organisms has increased drastically due to agricultural malpractices and industrial processes. In particular, exposure to organophosphorus insecticide can impart several harsh effects on human health. The development of efficient detection systems can be crucial in monitoring the organophosphorus pesticide. Thus, we are focused on the detection of these pesticides using ssDNA aptamers. Aptamers are oligonucleotides having the ability to bind target molecules with high affinity and specificity. Systematic evolution of ligands by exponential enrichment (SELEX) is widely used for aptamer selection. Gold nanoparticles (GNP) assisted SELEX is a method of aptamer selection for small molecules. This is based on strong affinity conjugation between the target and nucleotides which obviates the need for immobilization of the small-size targets for aptamer selection. Further, the nonspecific aptamers are easily removed with the help of GNPs with have an affinity with DNA nucleotides. Here, we have developed aptamers against the organophosphorus pesticide using GNP-SELEX. 20 nm-sized citrate-capped GNPs were synthesized and characterized using UV-vis, DLS and TEM. The pesticide-specific aptamers were selected in just 8 rounds of SELEX. In future, a highly specific aptamer will be selected from these aptamer candidates and will be used for electrochemical detection of pesticides in environmental and biological samples.

Single-ingredient white light emission of $CaMoO_4:Dy^{3+}$ phosphor by Sm^{3+} co-doping.

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The research in developing a single ingredient phosphor for white-light emission is progressively increasing. It is well known that the $^4F_{9/2} \rightarrow {}^6H_{13/2}$ (yellow at 574 nm) and $^4F_{9/2} \rightarrow {}^6H_{15/2}$ (blue at 484 nm) transitions of Dy^{3+} ions give near-white light emission but lack red color in its emission. Due to which it has a Correlated Color Temperature (CCT) of more than 5000 K, which is not comfortable for the human eye. In this paper, a series of Dy^{3+}/Sm^{3+} doped and co-doped $CaMoO_4$ samples were synthesized successfully via the urea assisted auto-combustion method. The PL emission spectra reveal that 4% Dy^{3+} doped $CaMoO_4$ phosphor shows maximum luminescence intensity. Further, Sm^{3+} ions are co-doped in 4% Dy^{3+} doped $CaMoO_4$ for improving their luminescence properties. In this paper we have successfully explained the energy transfer mechanism between $[MoO_4]^{2-}$ groups and Dy^{3+}/Sm^{3+} ions under the excitation of the host. After Sm^{3+} co-doping in 4% Dy^{3+} doped $CaMoO_4$, apart from the two dominant emissions of Dy^{3+} ion, another red colored emission at 647 nm is obtained, which is associated with the $^4G_{5/2} \rightarrow {}^6H_{9/2}$ electric dipole transition of the Sm^{3+} ion. Thereby improving the white emission of $CaMoO_4$:4Dy^{3+}, and for 3% Sm^{3+} co-doped $CaMoO_4$:4Dy^{3+} phosphor, white light is obtained with the CCT value of 4439 K (<5000 K). The Dy^{3+}/Sm^{3+} co-doped $CaMoO_4$ phosphor gives overall excellent white light emission. Hence, the prepared phosphor might be used in white lighting diode applications.

Keywords: $CaMoO_4$, Dy^{3+} ion, Sm^{3+} ion, Photoluminescence, Energy transfer.

REGIOSELECTIVE ULTRASOUND ASSISTED RING OPENING OF EPOXIDES VIA $CuFe_2O_4$ AS A HETEROGENEOUS MAGNETIC NANO-PARTICLES

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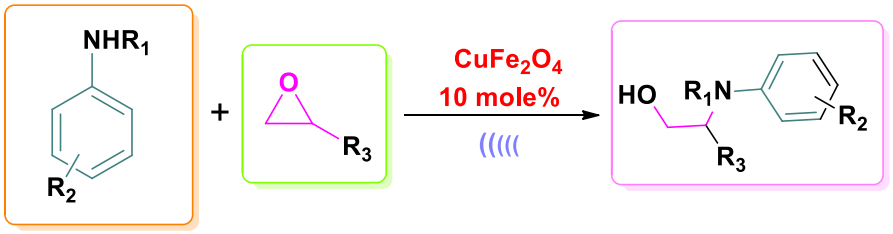
KEYWORDS: Environment benign Catalyst; Heterogeneous Catalyst; Aminolysis; Regioselective; ultrasound assisted; magnetic nanoparticles.

Development of highly efficient, reusable, economically viable, environment benign catalyst is highly desirable in the present scenario of exhaustive industrialization globally to save mother earth. Heterogeneous catalyst like $CuFe_2O_4$ magnetic nanoparticles may be one of the option to mitigate mentioned global issue. Copper ferrite nano catalyst, a highly efficient catalyst, has been used for the nucleophilic ring opening of epoxides with all aromatic, aliphatic and heteroaromatic primary as well as secondary amines under ultrasound assisted condition. Aminolysis is highly regioselective in nature for the synthesis of b-amino alcohols. MNPs were characterized SEM, X-rays and EDX moreover; all the products are characterized by NMR (^1H &^{13}C), FTIR, HRMS.



R_1= Me, H
R_2= Me, OMe, OH, Br
R_3= CH_2Cl, Ph

β–Amino-alcohol
81-92%
14-examples

Addressing bacterial infections using magnetic nanoparticle-mediated approach

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The extensive and indiscriminate use of antibiotics significantly contribute to the growing number of multiple drug resistant (MDR) bacteria. With the dwindling pipeline of new and effective antibiotics, we might be soon heading towards a post-antibiotic era, in which even common bacterial infections would be a challenge to control. To prevent this, an antibiotic-free strategy would be highly desirable. Magnetic nanoparticles (MNP)-mediated hyperthermia-induced antimicrobial therapy is an attractive option as it is considered safe for human use. Given that iron and zinc are critical for bacterial virulence, we evaluated the response of multiple pathogenic bacteria to these elements. Treatment with 1mM iron and zinc precursors resulted in the intracellular biosynthesis of MNPs in multiple Gram-positive and Gram-negative disease causing bacteria. The superparamagnetic nanoparticles in the treated bacteria/biofilms generated a significant temperature rise (5-6 ^oC) on exposure to an alternating magnetic field (AMF) resulting in a dramatic decrease in viability. Furthermore, we observed MDR bacteria derived from infected samples to harbour MNPs, suggesting the bacteria had biosynthesised the MNPs using the metal ions acquired from the host. AMF treatment of the bacterial isolates from infected specimens resulted in a strong reduction in viability (3-4 log) as compared to Vancomycin/Ciprofloxacin treatment. The therapeutic efficacy of the MNPs to induce bacterial death with AMF alone was confirmed ex vivo using infected tissues. Our proposed antibiotic-free approach to kill bacteria by using the intracellular MNPs is likely to evolve as a promising strategy to combat a wide range of bacterial infections.

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Innovative Engineered Nanomaterials for Environmental Remediation and Sustainability

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In the era of modern technology, for the progress of civilization, it is utmost significant to address the prime global issues pertaining to increase in population and pollution owing to urbanization and industrialization. In the emerging technologies, nanotechnology is the pivotal tool to resolve problems related with environmental sustainability and energy which are in the midst of deep crisis. In view of the eco-damaging factors involved with conventional methods (chemical/physical) of nanomaterial synthesis, the non-conventional (greener) approach is vividly advocated for the production of nanostructured materials. Non-conventional route employing indigenous natural resource, weeds, invasive species, etc., richly constituted with bioactive phytochemicals which act as reductant, stabilizer and capping agent, has been successfully used to fabricate innovative engineered nanostructures materials. Innovative engineered nanomaterials have proficiency to eradicate environmental toxicants/pollutants compared to bulk materials. A number of bulk materials showed astounding features when probed at nano scale. Innovative engineered nanomaterials play significant role in many sectors, viz., biomedical, pharmaceutical, life-sciences, catalysis, optics, solar cells, energy conversion, metal and other industries, etc. Their efficacy as photocatalyst, corrosion-impeders, eradication of aquatic-pollutant, and many other noteworthy utilities has also been investigated. Fabricated innovative nanomaterials have been verified by carrying out characterization using standard tools and techniques, viz., FTIR, UV-vis, FL, AFM, SEM-EDS, XRD, etc. Compared to conventional approach, the non-conventional approach has many advantages, viz., toxicant-free, eco-friendly, easier, economic, energy-saver, fast, and reliable. Consequently, now-a-days, the scientists and researchers ardently advocate adopting globally the non-conventional (green) approach to fabricate nanostructured materials for sustainability and environmental remediation. Over a decade, it has witnessed as a mile stone in conserving environment.

Dielectric Behaviour of Bismuth Borate Glasses having Dysprosium and Samarium as Co-Dopant: Sensing Device Material.

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Since less attention was paid to study of electric properties of glasses doped with RE ions, in present work conductivity (ac and dc) and dielectric properties of Dysprosium (Dy^{3+}) and Samarium (Sm^{3+}) ion co-doped $60B_2O_3 \bullet 30LiF \bullet 10Bi_2O_3$ glasses were examined. Conventional melt quench method was used to synthesize the amorphous glass samples [1]. It was observed that dc conductivity obeyed the Arrhenius law and the ac conductivity followed Jonscher's Power Law. The Conductivity mechanism

was investigated on basis of the trend followed by frequency exponent "s" parameter and all the compositions satisfied the Overlapping large polaron tunneling (OLPT) model. Dielectric properties: Dielectric Constant (ε`), Dielectric loss (ε``) and tangent loss (tanδ) were also investigated and observed to decrease with frequency and finally attained a minimum constant value at higher frequencies [2]. The high rate of change in dielectric properties at low frequencies was attributed to space charge polarization while at higher frequencies it was decreased due to inertia of ions. Cole-Cole plots encompasses depressed semicircular arcs which evidenced the presence of constant phase element and non-Debye relaxation behavior.

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Engineering the properties of Au/GeO_2 thin films using swift heavy 100MeV Ag ion irradiation

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In the present work, we report the effects of heavy ion beam irradiation on the modification of structural, optical and photoluminescence properties of Au coated GeO_2 thin films. GeO_2 thin films grown by electron beam evaporation on to silicon substrate and after that a thin layer of Au were deposited on to GeO_2 thin films. Eventually the prepared samples were irradiated with 100 MeV Ag ions at different ion fluences ranging from 1×10 12 to 1×10 13 ions/cm^2 . The pristine and irradiated samples were characterized using XRD, RBS, SEM, AFM, UV-Vis reflectance and absorbance and photoluminescence Spectroscopy. The results reveal that the nucleation of Au NCs was observed with increase in fluence. The elemental composition and film thickness observed using RBS measurements. The surface morphology and topography results reveal that the nucleation of particles with increase in ion fluences. Broad PL band observed in visible region which corresponding to the green light emission due to the presence of Au NCs. The variation in PL band was observed due to irradiation. The PL results implies that electronic transition of band structure possible after irradiation. The detection of light in visible region can be attributed to the oxygen vacancy related defect states as well as surface Plasmon resonance (SPR) induced absorption and subsequent electron injection from

Au NPs to conduction band of GeO_2 . The variation in electronic transition of wide band gap GeO_2 NC's by nucleation of gold NP's are considered to practical application in optoelectronics devices such as wavelength detection and optical switching devices. The possible mechanics of ion beam modification on the structural and optical properties of Au/GeO_2 thin films have been discussed in details.

Unveiling Extraordinary Magnetoelectric Coupling in Room Temperature Z-Type Hexaferrite Films

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Keywords: Multiferroic materials, Magnetoelectric coupling, Z-type hexaferrite thin films, Magnetoelectric devices.

In this talk, we explore the fascinating realm of multiferroics and their extraordinary magnetoelectric (ME) coupling in thin films. This intriguing phenomenon, which involves the simultaneous presence and coupling of electric and magnetic orders, holds great promise for applications in spintronic devices and provides insights into spin-lattice coupling. Researchers have proposed diverse mechanisms to enhance ME coupling in both single-phase and composite multiferroics, resulting in the continuous discovery of novel materials and structures. Addressing the challenge of achieving strong ME effects in thin films of hexaferrites, typically observed in bulk materials near room temperature, we present a study on the magnetoelectric coupling of epitaxial thin films of Co_2Z-type hexaferrite $Ba_{0.3}Sr_{2.7}Co_2Fe_{24}O_{41}$ (BSCFO) grown on a $SrTiO_3$ (111) substrate. Quantitative analysis reveals that the ME susceptibility and modulated electric polarization (ΔP) induced by a magnetic field in the BSCFO films consistently exceed those of the Co2Z-type single crystal by approximately 2-15 times, with further enhancements observed as the q_x broadening in the (0014) and (0018) peaks increase. Notably, the off-centered octahedral sites, primarily contributing to ΔP through the p-d hybridization mechanism, demonstrate that the orientational disorder can further enhance effective off-cantering. These findings, combined with the observation of the four-bit memory effect in the P versus H curves, highlight the potential of ME hexaferrite films for multifunctional device applications, paving the way for next-generation nano-electronic devices and multibit nano-memories.

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Supramolecular Assembly of Multifunctional Organo-Clay Hybrids

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In this lecture introduction about the research activities going on at our laboratory will be presented with a special emphasis on our ongoing work on organo – clay hybrid thin films. Nano-dimensional clay materials have attracted great interest as host materials over the past decade because of their unique interlayer spaces, flat large surface, negatively charged layer, and ion-exchange properties, intercalation and exfoliation / stacking ability of the nanosheet of clay; and modifiability of their surface with ionic / neutral organic molecules. It is well known that molecular structure not only determines its properties but also its patterns when assembled onto different restricted geometry and in ultrathin films. It has been observed that the photophysical and photochemical properties of organic molecules markedly when incorporated into clay materials. The planarity of the π-conjugated system of the confined organic molecule is increased, which extends the π-conjugation length. Also, the fluorescence quantum yield of the dyes is enhanced due to the suppression of vibrational motion of the confined molecules. In addition, aggregation pattern of the dye molecules changes markedly when assembled onto clay layers. Accordingly, organic molecules confined in nano-order clay−organic hybrid systems often exhibit unique opto-electronic properties that are not observed in their solution or crystalline states. In our lab the research has been motivated by a purpose of developing functional materials such as sensors, electrode-modifiers, nonlinear optical devices and pyroelectric materials, energy transfer, different order aggregates etc based on organo-clay hybrids. Various techniques such as Langmuir – Blodgett (LB), spin coating, Layer-by Layer (LbL) self assembly, suction - filtration (self standing films) etc can be used to prepare clay-organic hybrid films. With a suitable choice of molecules & film deposition techniques films can be prepared, which show improved mechanical stability, optical switching, nonlinear optical (NLO) properties, two photon absorption (TPA), J dimer and fluorescence resonance energy transfer (FRET), colour switching properties etc.

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Probing Dy site occupancy in $SrZnO_2$ system through X-ray absorption near edge structure

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The response of rare earth dopants in a particular host system is highly controlled by lattice site symmetry [1-3]. In this study, the in-depth analysis of local electronic structure of Dy doped $SrZnO_2$ is presented by probing theoretical and experimental X-ray absorption near edge structure (XANES). $SrZnO_2$ host exhibits two cation lattice sites (Sr and Zn) with varied coordination environment [4]. Upon Dy doping, the system exhibited charge transfer induced cold white emission, consisting $^4F_{9/2}\rightarrow{}^5H_{13/2}$ (yellow) and $^4F_{9/2}\rightarrow{}^5H_{15/2}$ (blue) lines with former being dominant [5]. The preferred site occupancy of Dy in $SrZnO_2$ is deciphered after comparing experimentally procured XANES at Zn K-edge, Sr K-edge and Dy L3-edge with that generated from real space full multiple scattering-based simulations. For Zn K-edge XANES simulations, second coordination shell around Zn was introduced with varying Dy occupancies, along with oxygen vacancies. It was found that Dy is occupying Sr sites at low doping concentration and started occupying Zn sites also with increase in doping content. On the other hand, Dy L3-edge exhibited suspicious double peaked feature at high doping concentration, which was found to be signature of cation site occupancy (Sr or Zn) of dopant in $SrZnO_2$ lattice. The study provided reliable results when compared with finding of photoluminescence and helped in explaining the trends in site occupancy of dopant in $SrZnO_2$ host, which will assist in predicting various properties of system for futuristic investigations.

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ANATOMIZATION OF NARCOTICS DRUGS CONFISCATED IN PROVINCES OF INDIA

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India has the highest rate of opiate users in the world. The trend is anticipated to rise with an increase in the trade of drugs. With the increase in the consumption of drugs across India, it has become important for the Government and law enforcement agencies to handle and supervise the situation as it has put every individual in pain and discomfort. Authors agree that a combination of demand and supply is the main reason for the same. The authors tried an attempt to systematically analyze and study the drug seizure across states and union territories of India, and the inter-state relations based upon the dealing of drugs through accessible facts and figures. India lies between the opium producing regions of the world that are the Golden Triangle on one side and the Golden Crescent on the other. Since Punjab shares a border with Afghanistan and Pakistan, it has become a major transit route in the smuggling trade. As a result, heroin, opium, poppy husk, morphine, cocaine and hashish have a high degree of severity and are readily available. The geographical location of north-eastern states and its easy access to drugs and other psychotropic substances have made these activities widespread throughout them. Mainly, the union territories have low consumption and seizure of drugs due to their less population and high security checks at ports while transportation. The authors drew the inference that, after analysis and visualization, peer pressure, unemployment, easy availability and porous borders are the few major reasons for the high consumption and seizure of drugs among the states of India. As a result, the information provided will assist concerned authorities, such as the Narcotics Control Bureau (NCB), to conduct themselves in an informed manner and facilitate the improvement of the situation of the county. The study of the authors revealed that by using various data mining techniques in order to analyze the drug seizure dataset, it also makes an effort in raising awareness regarding the harmful effects of drugs on the body and their health-threatening consequences.

Fractional Order Single Balanced Mixed, Design and Simulation

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Fractional calculus as a subject is being applied to diverse fields of engineering and science such as electromagnetics, visco-elasticity, fluid mechanics, electrochemistry, biological population models,

and signals processing. The fractional differential equations have been used for modeling physical and engineering processes. If we need to do mathematical modeling of real-life problems, the fractional differential equations come to our rescue encompassing special functions of mathematical physics along with their extensions and their generalizations in one or more variables. The differentiation and integration of non-integer orders have been in widespread usage in various domains of science and engineering. The employment of fractional order elements offers greater degree of freedom to the circuit designer since now the functioning depends upon an additional parameter α (fractional order) rendering a greater generic control.

Mixers are an important part of wireless communication systems. In communication system, mixing is considered as the frequency translation of the signal from one carrier to another or either attaching or removing the baseband signal to or away from the carrier. It is a three-port device which can modulate or demodulate and can be both active or passive. Mixers are also an essential part of wireless communication systems. When two signals are passed through a RF non-linear circuit, at the output additional signals of new frequencies are formed. These additional signals appear as sum and difference of input frequency components. This work presents a single balanced mixer topology in 32nm MOS node. This paper focuses on single balanced active mixer topology. This topology has been designed using both conventional capacitors and fractional capacitors for a certain order, α. In non-linear mixing signals are multiplied together to generate a whole new set of frequencies. A single balanced active mixer is designed for both conventional and fractional topologies. Fractional mixers of different orders have been presented to better understand mixing in fractional domain. Using a MATLAB program, R, C coefficients for fractional capacitors of order, α=0.52 and 0.81 have been determined. Mixing has been performed for both conventional and fractional topologies

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Environment Friendly Piezoelectric Nanogenerators for Medical Applications

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Piezoelectricity based nanogenerators is required for the energy requirements of body implantable sensors and transducers. Piezoelectricity is a phenomenon electrical signal can be generated by application of force, including those exerted by body movements. These electrical signals can be used for remote monitoring and treatment in medical applications [1].

In the present talk we will discuss our recent results in respect of synthesis of many high performing piezoelectric nanoparticles based on pure and doped ZnO, ZnO: GO hybrids and lead / alkali perovskires and their characterization in respect of structural purity, morphology, electric and optical properties. These nanoparticles are used to fabricate flexible nanogenerators with PENP-PDMS-ITO structure [2-5]. The performance of these energy harvester has been tested with a changing impulse and frequency of tapping force using a force simulator and shown that the output open circuit voltage remains unchanged even after many thousands strokes. It has been demonstrated that simple finger tapping, knee/wrist bending, foot strokes or mouth air blow can generate sufficient electric energy for various medical applications.

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Influence of the MWNT based Hybrid compatibilizer on the PA6/ABS Blends Mechanical Properties

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Binary blends of polyamide6 (PA6) and acrylonitrile-butadiene-styrene (ABS) have been selected as a model blend system due to its academic and commercial interest. It is also recognized that PA6/ABS blends without a compatibilizer exhibit inferior mechanical properties. In this context, various compatibilizers are reported to influence the phase morphology of PA6/ABS blends, which lead to a significant improvement in mechanical properties. the classical compatibilization strategy, nanofillers (clay, silica, carbon nanotubes, etc.) are reported to exhibit ‘compatibilization-like’ action by altering the viscosity ratio of the blends due to the localization of the filler in one of the phases or at the interface of binary polymer blends. CNT (carbon nanotubes) have been considered as an ideal

material for reinforcement due to their exceptional mechanical, thermal and electrical properties. The major challenges associated with the CNT dispersion involve the formation of 'aggregates' and of inadequate interfacial interaction between the polymer matrix and CNT [1-3]. The objective of this work is to investigate the influence of multiwall carbon nanotubes (MWNT) based hybrid compatibilizer on the phase morphology of melt-mixed 80/20 (wt/wt) PA6/ABS blends. Torque data during melt-mixing has been analyzed in order to investigate the effect of melt-interfacial reaction and the addition of MWNT on the melt-viscosity of various compositions of 80/20 (wt/wt) PA6/ABS blends. Dynamic mechanical thermal analysis (DMTA) has been carried out for the selective compositions of 80/20 (wt/wt) PA6/ABS blends to study the effect of various compatibilizers on the storage modulus and the tanδ of the blends.

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ADSORPTIVE REMOVAL OF As^{3+} and As^{5+} FROM GROUNDWATER USING INDIAN ILMENITE

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The metalloid arsenic is one of the most notorious groundwater contaminants in the Indian subcontinent. Every day millions of people in the states of West Bengal, Jharkhand, Bihar, Uttar Pradesh, Assam, Manipur and Chhattisgarh face an unknown horror by the simple act of consuming untreated groundwater. Owing to these facts of life there is an urgent need for a cheap, reliable, rapid and readily deployable means of removing this dissolved arsenic from water. In this study we have used beneficiated Ilmenite as adsorbent. Ilmenite is a black mineral with the formula FeTiO3 that is commonly found on the southern coast of Kerala, India. It exhibits characteristics that make it an ideal candidate for arsenic adsorption. The aim of this project is to determine the viability of using Indian Ilmenite to adsorb As(III) and As(V) from groundwater and to optimise this process. To this end enriched (electrostatic separation) Ilmenite sand, was activated by acid treatment and used to adsorb arsenic from prepared solutions. Various parameters such as pH, loading rate, temperature, time and loading concentration were varied for optimising the adsorption process. The resulting solutions were analysed by quantitative colorimetry using a UV-Vis spectrophotometer. This resulted in complete removal of the arsenic from the samples tested. The study revealed that ilmenite is an excellent adsorber of As(III), which could achieve near complete adsorption in a span of about 1hr. Ilmenite functions effectively in the pH range of neutral to moderately acidic, making it an ideal adsorbent for ground water treatment. Even at modest concentrations of As(III) in solution (5 mg/L), ilmenite demonstrated good adsorption capacity. Compared to its low cost, ready availability and ease of preparation, only a modest quantity (20g/L) is required for water treatment. The thermodynamic parameters that were analysed suggested that As(III) adsorption on ilmenite was favourable, spontaneous, and endothermic.

Interface Solar Steam Generation: A Greener Alternative for Water-Energy -Nexus

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Water and energy scarcities are major global concerns that are often interconnected. However, water and energy technologies are independent, and combining these two with separate infrastructures ultimately leads to high costs and low energy utilization efficiency. Hence, finding a synergetic low-cost solution to overcome water and energy shortage is crucial. Interfacial solar steam generation (ISSG) has emerged as a promising environment-friendly, low-cost, and sustainable approach for freshwater generation by enhancing solar evaporation using sunlight as the sole energy source. This report presents a simple method of all-day-long electricity production in solar steam generation. By simply conducting seawater from the reservoir to the evaporator surface (area 1.5 cm × 1.5 cm) by filter paper strips, enough electricity was produced to glow an LED or run a calculator simultaneously without using any energy storage devices. For the first time, we could generate sufficient electricity from a single evaporator in a continuous manner to realize practical applications without scaling up, even in the dark. Our device promotes interface solar steam generation as a promising alternative to the solar-driven-water–energy nexus.

Hydrogen Generation through Overall Water Splitting using Functional Nanocatalysts

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Multifunctional nanostructures find the possibility for their applications in water splitting processes for hydrogen generation as a renewable source of green energy. The studies of some multifunctional nanoparticles especially heterostructures by chemical synthesis reveal the formation of monophasic structures with fairly uniform distribution of nearly spherical particles, high specific surface area and visible optical band gap. Photocatalytic generation of hydrogen in water splitting process by using as-prepared doped and heterostructure nanoparticles has also been studied under the visible light irradiations which showed a significant H_2 evolution reaction rate. The development of nanostructured catalysts has also been preferred to carry out the heterogeneous catalytic organic transformations because of greater number of surface-active sites for catalytic processes, high catalyst recovery rate, especially their environment friendly nature and their ease of synthesis. Herein, we also discuss some nanocatalysts for certain organic transformation reactions with enhanced activity as well as in water splitting reactions for hydrogen production.

Manifestation of the polymorphic state on pyroelectric and ferroelectric properties of the lead-free BZT ceramics

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Ferroelectric barium titanate exhibits polymorphic phase transitions from rhombohedral to orthorhombic T_{R-O} ~ -90 ^{o}C, orthorhombic to tetragonal T_{OT} ~ 5 ^{o}C, and tetragonal to cubic T_{TC} ~ 120 ^{o}C. The transition temperatures T_{R-O} and T_{OT} increase while the T_{TC} decreases with the incorporation of Zr^{4+} in the barium zirconate titanate ($Ba(Zr_x, Ti_{1-x})O_3$ (BZT) ceramics and these transition temperatures merge for Zr content ~ 0.15 which is termed as a pinched transition. The coexistence of rhombohedral, orthorhombic, and tetragonal phases in the vicinity of the pinched transition leads to a dielectrically soft state due to flattened free energy and facilitates easy rotation of polarization which can augment the ferroelectric and pyroelectric response of BZT ceramics. Two ceramic compositions (a) Cd-doped BZT with Zr/Ti 13/87 and (b) Ca-doped BZT with Zr/Ti 10/90 have been synthesized using the solid-state reaction method. XRD and Raman measurements on the Cd-doped BZT and Ca-doped BZT ceramics reveal the coexistence of all three crystal phases. The pyroelectric response of Cd-doped BZT has been investigated using the Byer – Roundy method and one of the largest pyroelectric coefficient 1841$\mu C/m^2K$ has been observed for $(Ba_{0.94}Cd_{0.06})(Zr_{0.13}Ti_{0.87})O_3$. The dynamic characterization of IR sensor made from Cd-doped BZT ceramics for intruder detection has also been done using a lock-in-amplifier and optical chopper. The microstructure and ferroelectric response of Ca-doped BZT show significant improvement with sintering temperature and dwell time. Ease of polarization rotation in the polymorphic state, and a large ceramic grain size contribute to the strong pyroelectric and ferroelectric response.

Joining of CFRP to Mild Steel Using Electro-Explosive Clinching Process

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In the conventional clinching process, two sheets are interlocked using a punch and die. The clinching process is the most widely used process in the metal joining industry for achieving the required strength without any formation of intermetallic. In this manuscript, work has been carried out on the high strain rate metal clinching process. High strain rate is a process where strain rate varies from $10^3 – 10^5$ S^{-1}. For a high strain rate, electro-explosive equipment is used for joining carbon fiber reinforced plastic (CFRP) to low carbon steel (LCS). A novel method is carried out for the first time using this process. Experiments are carried out at various discharge voltages to find the most suitable voltage taking into consideration of mechanical strength as one of the parameters. This research work will demonstrate the feasibility of the clinching process using the electro explosive high strain process.

Bioactive nanocrystalline Wollastonite prepared by Combustion Method Using different shells waste as calcium source.

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Wollastonite ($CaSiO_3$) is a biomaterial that belongs to the class of Calcium silicates. The property of wollastonite to bond with living bones has received lot of attention in biomedical engineering field.

The characteristics of a bioactive material is its ability to form hydroxyapatite layer on its surface in presence of physiological environment,which provides the bonding interface with the tissues and bone. In the present study combustion method was employed to synthesise nanocrystalline wollastonite by taking Egg, Clam, Crab shells waste as calcium source and silica gel as silicate source. Hydrazine hydrate was used as reductant/fuel and citric acid as an oxidizer. The infra red spectrum shows the characteristic peaks for Ca-O, O-Si-O showing the functional groups of wollastonite. X-ray diffraction pattern confirms the single phase purity for nanocrystalline wollastonite. SEM images show that particles are agglomerated.The bioactivity of wollastonite was investigated by immersing the scaffold in a simulated body fluid for 7 days, and the surface can generate the bone-like apatite stone granulate. Intermediate analysis of the surface by XRD shows the deposition of hydroxyapatite layer after 5 days. Antibacterial activity was also monitored for escherichia coli and staphylococcus aureus. This study shows good biological activity and antibacterial property so as to be used for bone tissue restoration and replacement.

SIGNIFICANCE OF THE DRUG LOADING APPROACHES OVER DRUG DISTRIBUTION AND BIOLOGICAL EFFICACY OF EXOSOMES

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Exosomes are natural lipid-based nanovesicles derived from biological fluids, fruit juices, etc, and are extensively employed as drug carriers (Dad et al., 2021, Zhang et al., 2019), although, the pattern of drug distribution i.e., whether loaded inside the exosomes or attached on the surface is still unclear. So, to solve the mystery, we have formulated paclitaxel (PAC), and 5- fluorouracil (5-FU) loaded exosomes, derived from bovine milk. The drugs were loaded using three different methods namely, incubation, sonication, and triton x-100 (Kim et al., 2016, Gray et al., 2015). The exosomes showed an average particle size of 150 nm for all three methods, with a slightly increased drug loading, and controlled release for sonication method. Moreover, the loading preferences of the drugs in exosomes were analyzed using a fluorescence spectrophotometer, EDX mapping, XPS, and XRD analysis (Chebakova et al., 2021, Ghataty et al., 2023). Results indicated the presence of more drugs over the surface in the case of incubation, which suggested that a part of the drug gets entrapped within the exosomes, while another gets attached on the surface. However, the loading methods demonstrated insignificant cytotoxicity, as confirmed by the MTT assay, although the combination offered a synergistic anticancer activity. The study inferred the superiority of the sonication method, compared to incubation and triton x-100, without compromising the efficacy of the exosomes.

Keywords: Exosomes; Paclitaxel; 5-fluorouracil; Combination therapy; Synergism

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Photocatalytic and Antimicrobial activity of ZnO and ZnO/Pani nano composites

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Human body gets affected from the infections arising from the colonisation and development of Gram-positive bacteria, Gram-negative bacteria, and multidrug-resistant bacteria. Metal oxides can be good alternatives to this infection due to their efficient antimicrobial activity. Besides TiO_2, ZnO is the second most extensively used photocatalyst exhibiting excellent photocatalytic activity, stability and almost similar band gap energy (Ebg 3.2 eV and 3.0 eV, respectively). In the present work ZnO nanoparticles were synthesized using xylene as a phase transfer agent. The formation ZnO nanoparticles was confirmed by UV Visible spectroscopy. The samples were characterized using FTIR, SEM, EDAX, XRD respectively. The average crystallite size of ZnO was found to be 40.2 nm by X-ray diffraction. FTIR spectrum exhibited vibration modes at 420 $Cm^{-1.}$ The antibacterial activity of the ZnO nanoparticles were investigated against E. coli and Bacillus using disk diffusion method. ZnO/Pani nanocomposites were confirmed by FTIR, SEM, EDAX Antimicrobial activity of ZnO showed 7mm for E. Coli & 10mm for bacillus. The photocatalytic degradation of of methylene blue under UV light was carried out with undoped ZnO and doped with polyaniline in the ratio of 1:3. Photocatalytic degradation percentage was found to decrease when ZnO was doped with Pani.

Investigation on the Performance of Bauxite residue (Red Mud) Based Interlocking Masonry Unit

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Red mud (RM), also called as Bauxite residue is obtained as a byproduct from the Bauxite ore in the process of Extraction of Aluminum. Annual production of alumina in 2020 was over 133 million tonnes resulting in the generation of over 175 million tonnes of red mud as waste globally according to the annual statistics collected and published by World Aluminium. It is very alkaline, and a waste material that consists of radio-active elements and heavy metals. This waste material creates various environmental issues such as it affects the human lungs and skin, Flora-Fauna, Aquatic biota, and soil biota etc. In the conventional way of disposal of red mud are stockpiled in ponds and its disposal seems tedious process. To conclude various environmental problems it is suggested to use the red mud as ingredients in construction materials. One potential way to use this waste material as building materials in the form of concrete making materials and brick ingredients. The present study is, adding red mud as an ingredient along with cement, Fly ash and M-sand in manufacture of Interlocking masonry unit. In this study RM is used as an alternative to soil in manufacturing of Interlocking masonry unit. Five different proportions of red mud, cement, fly ash and M-sand were used to investigate the compressive strength of the masonry unit. Mix 1 (70%, 10%, 10% & 10%), Mix 2 (60%, 10%, 10% & 20%), Mix 3 (50%, 15%, 10% & 25%), Mix 4 (40%, 20%, 10% & 30%) & Mix 5 (30%, 20%, 30% & 20%) respectively. The trial mix were prepared to study the compressive strength at the age of 3, 7 & 28 days of curing and it gives increasing in compressive strength from trial mix 3, mix 4 & mix 5 of compressive strength 12 – 15 Mpa. Based the test results, it is suggested to us the proportions of all three mixes (Mix 3, 4 & 5) as per the site requirements.

Biogenic synthesis of copper oxide nanoparticles using green waste for the application of grow light

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The use of bio-waste materials for synthesizing metallic nanoparticles is a promising approach for addressing waste disposal issues and promoting environmental sustainability. This study focuses on the biogenic synthesis of copper oxide nanoparticles using waste peels from banana, potato, and peas. The yields of the prepared materials from banana, potato, and peas waste were 1.0, 1.0, and 1.2 g, respectively. Various characterization techniques, including X-ray diffraction analysis (XRD), scanning electron microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDX), Fourier-infrared spectroscopy (FTIR), UV-visible spectroscopy, and fluorescence spectroscopy were used to analyze the prepared nanoparticles. The XRD peaks confirm the formation of copper oxides, which have a monoclinic structure that matches well with the JCPDS-card. FTIR also verifies the successful formation of copper oxide nanoparticles. The size and shape of the nanoparticles were determined using FESEM, while the EDX confirmed the presence of Cu-O. The UV-visible absorption spectrum was used to investigate the optical properties of the material, and the emission properties of CuO were studied at various excitation wavelengths, such as 310, 210, and 214 nm, which indicate that CuO is a suitable material for use in grow lights. Grow light spectrum refers to the electromagnetic wavelengths of light produced by a light source to promote plant growth. Overall, this study demonstrates the potential of using bio-waste materials for synthesizing metallic nanoparticles, which could have important applications in promoting environmental sustainability.

Augmented areal capacitance of manganese oxide nanorods on exposure to low energy nitrogen ion irradiation

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Nanorods-based supercapacitors show a great deal of potential for the development of adaptable and high-performance storage devices because of their high energy density per unit volume as well as their tolerance to high levels of mechanical stress. We demonstrated that the amount of charge that can be stored in a material can be raised by joining [1] a large number of manganese oxide nanorods together using an ion beam. After being spin coated on a silicon wafer and subjected to a very low energy (5 keV) N^+ ion-beam at varying ion fluences, the super capacitive performance of hydrothermally synthesised Mn_3O_4 nanorods was verified via an extensive electrochemical process. This process was carried out after the nanorods had been exposed to varying ion fluences. Nanorods made of Mn_3O_4 that have been subjected to irradiation have an outstanding areal capacitance of about 132 mF/cm^2. Irradiated Mn_3O_4 nanorods displayed improved charge storage performance when contrasted with their untreated counterparts. The comprehensive experimental findings shed light on the mechanisms that may be responsible for the increased charge-storage performance of irradiated nanorods [2]. Irradiation causes oxygen vacancies, which are responsible for the enhanced specific capacitance performance that is observed after irradiation, as demonstrated by TRI3DYN simulations. Irradiated samples have a high specific capacitance because of their enlarged surface area [3] as well as the oxygen vacancy that is created as a result of the irradiation. Ion beam irradiation can be used to fine-tune the surface area, conductivity, and storage capacity of the supercapacitor electrode, according to a new study that adds to the growing body of evidence that supports this proposition.

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Diels-Alder based self-healing of epoxy nanocomposites using bismaleimide functionalized GNP

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This work demonstrates Diels-Alder chemistry based self-healing of epoxy nanocomposites by grafting graphitic nanoplatelets (GNPs) with thermo-reversible bismaleimide. The flexural properties of the composites was found increased by ~21% and maximum healing efficiency was observed as ~75% due to incorporation of the functionalized GNPs. Thus this work demonstrates first time an innovative method to improve mechanical and healing efficiency of the nanocomposites.

Smart electrochemical sensors for pesticide detection

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In recent years, there has been an increase in pesticide use to improve crop production due to the growth of agricultural activities. Pesticides protect plant products from harmful, undesirable pests like insects, fungi, nematodes, herbs, weeds, rodents, bugs, and microbes. In India and worldwide, many pesticides are being consumed. Although pesticides can improve the yield and quality of agricultural products, excessive use harms the environment and organisms. Therefore, a lot of attention required for the detection of these pesticides in a rapid manner in food and agricultural samples. Conventional techniques like chromatography require sophisticated instrumentation and large sample quantities and skilled operators to run. Therefore, chemical or biochemical sensors are of interest which can detect very less quantities rapidly. The nanomaterials-based sensors provide high sensitivity and rapid detection. Here in, two electrochemical sensors in which one is the aptamer-based sensor and other is the MIP based sensor for the detection of Chloropirifos, Aldicarb respectively are discussed here.

Nanotechnology in Vaccinology

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Nanotechnology in vaccinology have fuelled rapid advancement towards design and development of nano-vaccines. Nanoparticles have been found to enhance the vaccine efficacy through spatiotemporal orchestration of antigen delivery to secondary lymphoid organs and antigen-presentation by Antigen Presenting Cells (APCs) synchronized with stimulation of innate and adaptive immune responses. Our team has worked extensively towards developing biocompatible nano-delivery and adjuavnting systems. We have developed several hybrid organo/inorganic, Polymer (PLGA), metal oxide, milk derived exosomes and engineered outer membrane vesicle (Figure 5) based nano-vaccine delivery systems. We have designed a novel mesoporous ZnO nanocapsule (mZnO) having size ~ 12nm with average pore diameter of 2.5nm, and have investigated its immunomodulatory properties by using Ova loaded mZnO nanocapsules [mZnO(Ova)] in a mice model. Our finding exemplifies that mZnO(Ova) administration steered enhanced expansion of antigen-specific T-cells and induction of IFN-γ producing effector CD4+ and CD8+ T-cells. Also, antigen-specific IgG levels were enriched in both serum and lymph nodes of mZnO(Ova) immunized mice (Figure 6A). Given the immunomodulatory characteristics of mZnO it reinforces that could be used as an effective antigen-adjuvant platform for the development of novel nano-based vaccines against multiple diseases. We also have come up with a novel rOMV technology, which might suffice the problem of antigen delivery as well as adjuvanting. Using such technology, it is possible to decorate nano-microbial vesicle with desired vaccine antigens singly or in combination from multiple pathogens retaining many of the immune-modulating and adjuvanting components of bacteria including TLRs. Thus,

rOMVs mimic the non-infectious physical form of bacteria, characteristics that make them a promising vaccine development platform. Using such technology, we have developed tetravalent nano-vaccine formulation against Dengue Virus. Mice immunized with rOMVs expressing Dengue antigens showed stronger B cell immune response compared to the control mice, which have received soluble antigens or antigen in combination with Alum adjuvant. The high titer antibody produced using rOMVs were able to completely neutralize all the serotypes of the Dengue virus. Interestingly, our preliminary data also reveals that antigen expressed in rOMVs and administered via oral/mucosal route triggers strong systemic IgA response, thereby suggesting that OMVs could be a potential mucosal nano-delivery system. Therefore, successful applications of nanotechnology in vaccinology might enable development of effective new generations multivalent vaccines against emerging and re-emerging pathogens, which pose a serious threat to global human and animal health.

Green emitting Dy^{3+}/Ho^{3+} co-doped $SrMoO_4$ phosphors for white light LED

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Keywords: $SrMoO_4$; Photoluminescence; Absorption Study; Structural Study; Rare-earth.

Green emitting Dy^{3+}/Ho^{3+} co-doped $SrMoO_4$ (Strontium Molybdate) phosphors were synthesized via co-precipitation method. The synthesized phosphors were subjected to structural and optical studies. The tetragonal crystal structure of the prepared phosphors is being validated by XRD. Absorption spectra of the prepared phosphors lies near UV region is shown by the UV-Vis analysis. A broadening in the absorption peak is observed as a result of the $Dy^{3+}$and Ho^{3+}doping. The FTIR analysis confirms the presence of O-Mo-O bending and Mo-O stretching infrared vibrations.[1] We have encountered a broadband centered around 297 nm and few characteristic 4f-4f transition peaks in the excitation spectra of the Dy^{3+} doped $SrMoO_4$, whereas, after exciting with 541 nm the Dy^{3+}/Ho^{3+} co-doped phosphors exhibit only 4f-4f characteristic peaks of Ho^{3+} ions. The emission spectra was recorded for all the prepared phosphors with 297 nm excitation wavelength. The overall emission of the Dy^{3+} doped $SrMoO_4$ shifts from yellow to green region with Ho^{3+}co-doping. These are the properties which make Dy^{3+}/Ho^{3+} co-doped $SrMoO_4$ phosphor, a promising candidate for the green light applications.

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Improved magneto-viscoelasticity of cross-linked PVA hydrogels using magnetic nanoparticles

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Magnetic nanoparticle (MNP) incorporation in soft host media offers great possibilities to control its properties and flow dynamics via external magnetic field. In the present work we report, synthesis of stable homogeneous crosslinked PVA hydrogels with MNP and their detailed rheological investigations in static and dynamics modes. The measurement results were fitted with the theoretical model presented for nonlinear and transient static & dynamic flow behavior. A good agreement has been observed with theoretical predictions confirming the high dispersivity and stability of these magnetic gels. MNP align themselves in the field direction, and field-induced structures produce hindrance to uniform stress flow which causes a nonlinear viscoelastic response. The substantial enhancement in viscoelastic properties in observed with incorporation of MNP. Static mode investigations show good yielding properties which increase with increase in MNP concentration whereas, dynamic mode storage/loss modulus response shows higher storage modulus than loss modulus. This enhancement indicates the dominance of solid-like nature of magnetic gel due to more significant field-induced structures over applied hydrodynamic forces. These magnetic gels show a quick response to the applied field which is established by transient viscosity response. The viscoelastic properties of these magnetic gels make it effective and efficient solution for numerous applications in the field of engineering and biomedical.

A comparative study of *Tectona Grandis* seed powder & *Mangifera Indica* leaf powder as bio adsorbents for their efficiency in Methylene Blue dye degradation

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Excess of methylene blue (MB) concentration (>5mg/Kg) is toxic to the marine ecosystem and the human being [1-4]. Textile industries are the important sources of dye release to the water bodies. Various dye degradation methods have been reported in the past. In our study bio adsorbent efficiency of *Tectona Grandis* (Teak) seed powder and *Mangifera Indica* (Mango) leaf powder for the MB dye degradation was investigated. Effect of pH, time, temperature, optimum concentration of the adsorbate, adsorbent concentration, Freundlich and Langmuir adsorption isotherms were studied. The study involved varying initial concentrations of dye by adding bio adsorbent at optimum pH 7. Results revealed that by using Teak seed powder - the 100 mg/L had maximum percentage removal & it was found to be 87.15 % at 60 min, whereas for Mango leaf powder - the results showed that 100 mg/L had the highest percentage removal of 59.75 % at 60 min. 10 mg was found to be optimum dye dosage. The percentage of dye removed increased as the adsorbent dose was increased. By using teak seed powder, maximum percentage removal of 55 % was observed at 10 mg, whereas mango leaf powder showed maximum percentage removal of 22.5 % at 10 mg.

Fine Motor Assessment using Automated Box and Block Test for Hand Rehabilitation

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Objective: Box and Block Test (BBT) is one such recovery method. The present work aims to automate the test of the unilateral manual dexterity of a patient's hand. The test helps to track the progress of dexterity during hand rehabilitation and reduces the clinical workload by providing the quick result.

Methods: A box consisting of 80 blocks is divided into two partitions. A motion tracking sensor MPU6050 sensor is placed on a wrist to get the orientation and acceleration of hand movement. Each participant is given 60 seconds to move the blocks. A colour sensor at the box monitors the block movements across the partitions.

Results: Ten participants with normal hand function were chosen to experiment with the age of 20 - 65 years (Mean = 44.1, SD = 14.57). The box plot shows block count (test score), which reduces as the participants' age increases. The independent t-test between traditional BBT and automated BBT, p=0.62, was observed with a 0.95 confidence interval. A positive correlation of 0.94 between traditional and automated tests indicates that the automated test can replace traditional BBT without altering the outcome.

Discussion: Automated BBT can help a wide range of patients to record the improvement of their hand injuries/conditions without the aid of a clinician, and this can be done in the comfort of their homes.

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Gold Nanoparticles: Plant mediated synthesis and their sensing and antimicrobial capability

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A lot of interest has been devoted to gold nanoparticles (AuNPs) due to various their remarkable antioxidant, antibacterial, sensing, and catalytic properties. Due to their compatibility and low toxicity, AuNPs have a wide range of applications. There is numerous physical, chemical, and biological methods that can be employed to synthesize AuNPs. Green nanoscience presently includes new domains of study as a result of the integration of green chemistry principles with nanoscience. In

contrast to other approaches, the biogenic synthesis of nanoparticles does not require the use of hazardous chemicals or high energy sources. AuNPs are synthesized using a variety of biological components, including fungus, enzymes, plants, and microbes. Due to their versatility, simplicity, and accessibility, plants are frequently employed in this process. Plant extracts function as capping and reducing agents, which promote the biogenic synthesis of AuNPs. This method of producing AuNPs is inexpensive, sustainable, and suitable for large scale production. I will elaborate the synthesis of plant extract-mediated AuNPs and their sensing capabilty for detection of heavy metal ions in a water as well as their antimicrobial efficacy.

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Effect of Composition on Thermal Stability of Cu-Ni Bimetallic Nanoclusters: Molecular Dynamics Simulation Studies

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Bimetallic nanoclusters have found applications in thrust areas of technology, such as: sensors, heterogeneous catalysis, photonics, magnetic devices, optoelectronic devices *etc*. Understanding the atomistic details of composition on the thermal stability of bimetallic nanoclusters is important for their potential application in diverse fields. In this study, molecular dynamics simulations in conjunction with the second nearest neighbour modified embedded atom model (2NN-MEAM) potential have been performed on Cu-Ni bimetallic nanoclusters to investigate the effect of composition on their thermal stability. The profiles of potential energy, specific heat, self-diffusion coefficient and radial distribution function with respect to temperature for various atomic compositions of the bimetallic nanoclusters are obtained to establish the results. Five nanoclusters containing 2048 number of atoms with increasing nickel concentration are studied: Cu-10%Ni, Cu-25%Ni, Cu-50%Ni, Cu-75%Ni, and Cu-90% Ni. Pure Cu and Ni nanoclusters containing the same number of atoms also are examined for comparison. Thermal stability was characterised by the melting phenomena of the nanoclusters. The results suggest that the Cu-75%Ni composition has the highest thermal stability. It is observed that the melting point of the bimetallic nanoclusters increased with increasing Ni concentration up to 75%Ni composition. However, for 90%Ni composition the melting point decreased. The melting point temperature of the bimetallic nanoclusters is found to be greater than that of pure Cu nanocluster (for all compositions) and that of pure Ni nanocluster (except

for Cu-10%Ni), indicating an enhancement in thermal stability upon alloying. Figure 1 depicts the variation of melting temperature of the nanoclusters as a function of Ni concentration.

X-ray Photoemission spectroscopy and electrical properties of A-site doped rare earth based R_2NiMnO_6 double perovskites

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Double perovskites of the form R_2NiMnO_6 (R = Rare-earth) are of great interest because they show a wide spectrum of properties and features like high dielectric constant, magnetism, ferromagnetism, magnetoresistance, magneto-coupling, magnetocapacitance, magnetocaloric effect, etc. [1–4]. In this study we shall discuss the structural, morphological, electronic, dielectric and conductivity studies of pure and A-site doped double perovskites of the form R_2NiMnO_6, where R is rare earth element. The compounds have been synthesized through solid state reaction route and have been confirmed to show monoclinic structure through X-ray diffraction. The surface morphology of the samples has been examined through scanning electron microscopy. We have investigated the electronic properties of samples through X-ray photoemission spectroscopy which depicts the multivalence of Ni and Mn ions in all the samples. The dielectric constant and dielectric loss studies have been carried out to see the impact of dopant on the dielectric constant and dielectric loss that too as a function of temperature as well as frequency. The variation of conductivity with temperature at different frequencies suggests the Negative Temperature Coefficient of Resistance (NTCR), thereby depicting the Semiconducting nature of pure as well as doped compounds. We also observed the presence of oxygen vacancies in these samples that are determining and explaining the electrical properties of compounds.

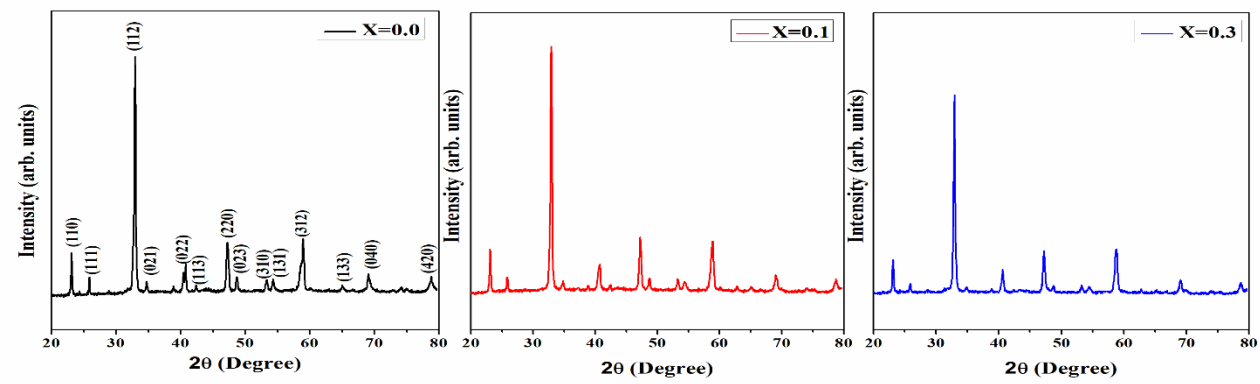

Fig. 1: XRD pattern of Sr doped R_2NiMnO_6 (R=Nd) at different concentrations

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Photocatalyst design for sunlight-driven scalable green hydrogen generation via water splitting

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Sunlight-driven photocatalytic water splitting process is promising to generate H_2 using a simple and cost-effective method. Despite these advantages and prospects, the photocatalytic approach is commercially feasible only after the successful demonstration of efficient, stable and large-scale solar H_2 generation. Over the last decade, intense efforts have been made to enhance solar to hydrogen (STH) conversion efficiency towards 5-10%. In this direction, photocatalytic overall water splitting (OWS) forms one of the promising approaches. In OWS, stoichiometric amounts of H_2 and O_2 are generated by a one-step excitation of a photocatalyst having conduction (CB) and valence band (VB) positions straddled with the reduction and oxidation potential of water.

Despite the advantages and prospects of the photocatalytic OWS method, the STH conversion efficiency is significantly lower than currently available expensive electrolyzers. In this talk, I will summarize about the basic principles of OWS, recent developments in various classes of photocatalysts (ABO_3-type perovskites, oxynitrides, g-C_3N_4, conducting polymers, and Ta_3N_5) employed. Emphasis will be on the importance of photocatalyst design via understanding the correlations between the optoelectronic, surface and structural properties with the OWS efficiency. Insight towards realizing scalable green hydrogen generation with 10% STH conversion efficiency via photocatalytic OWS will be discussed.

Controlling Cellular Processes via Chemically Designed Nanoparticle

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In past few decades there is significant advancement in biomedical applications of various nanoparticles. Current chalenges include designing nanoparticle that can readily cross the cell membrane, target different subcellular compartments and control intracellular processes. We design colloidal nanoparticle/nanobioconjugate of 10-50 nm size and use them to control various cellular processes. We found that cellular uptake and intracellular function of nanoparticle can be controlled by appropriately designed surface chemistry. We show that nanoparticle can be designed for energy independent direct cell translocation (without endocytosis) or preferencial lipid raft/caveolai-mediated endocytosis as compared to conventional clathrin-mediated endocytosis. Adapting these principles we design nanoprobes that can readily enter into cell, label different subcellular compartments, inhibit intracellular protein aggregation and clear toxic amyloid aggregates via upregulated autophagy. The talk will focus on property of our designed nanoprobes along with various application potentials.

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Experimental study of Ground Improvement Techniques of soft Kaolin Soil using Sand drain and Jute wrapped with polyamide polyester vertical Drain

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Thick alluvial deposits of soft clayey soils are characterised by low shear strength, high compressibility and low hydraulic conductivity. In recent years, soil improvement is required to provide adequate bearing capacity and improve shear strength of the soft cohesive soils to satisfy the need for various type of construction on sites underlain by such soft soils. Amongst various ground improvement techniques like vibroflotation, compaction with explosive, electro-osmosis, heavy tamping, stone column etc, the technique of preloading or pre-compression used in combination with vertical drains is one of the oldest and most widely used techniques to preconsolidate and strengthen weak compressible soils in situ. To accelerate the time of Primary consolidation, Prefabricated Vertical drains are used in soft clays as they decrease the drainage path. In this paper, we investigate the consolidation rate of soft soil with Sand drain and jute wrapped with polyamide polyester drain as PVD. The present paper focuses on Study of pore water dissipation, effect on consolidation due to radial drainage flow and gain in strength using 254 mm diameter Rowe Type Oedometer for both the drain materials. The load in increment of $\Delta P/P = 1$ is applied and measurement of settlement by conventional method is done. It is observed that Jute wrapped with polyamide polyester drain as PVD performs better in comparison to Sand Drain.

Possibilities of Light Scattering techniques for investigation of sub-micron Black *garlic* particles of health importance

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Light scattering is a technique which employs the exploration of the intensity of scattered light as a function of the angular distribution of small particulate matter having a size of nanometer or micrometre scale. The information obtained from the scattering profile provides vital information about the morphology of the scatterers. Our present work is based on the investigation of Black garlic (*Allium sativum L.*). It exhibits high bioactivity as reported earlier. The changes in physicochemical properties are the main reasons for the enhanced bioactivity of Black garlic compared with fresh garlic. We investigated the antimicrobial activity of Black garlic on bacterial growth of *E. coli*. The antibacterial activity was confirmed by biochemical methods. Subsequently, it was also endorsed by the light scattering technique. The observations of the activity were made at two different temperatures. The temperature-dependent anti-microbial action was studied because of its possibility of application in food products. The light scattering investigation of the samples was carried out by using a designed and fabricated He-Ne laser-based light scattering set-up, which made use of an incident wavelength of 632.8 nm. The scattered light intensity was obtained for different angles over an angular range of 10^{o} to 170^{o} in a goniometer arrangement. The changes in scattering profiles of the black garlic samples with and without the antibacterial action were noted at two different temperatures.

Also, the scattered intensity of light was measured by a camera sensor at three different positions in the goniometer scale. The antibacterial action pertaining to changes in the morphology of the bacterial cell in the Black garlic sample confirmed by biochemical methods was recorded by light scattering investigations. The scattering profiles of these samples have revealed the distinctiveness of each profile. This ensures the use of a light scattering tool as an alternate means of studying the bioactivity of back garlic without a biochemical approach. Therefore, light scattering is a non-invasive and non-destructive technique that can be used as an efficient tool for the characterization of biological or organic samples. In our present work, the antimicrobial activity and health importance of black garlic were confirmed by the light scattering tool for the first time. The detailed analysis and results will be presented during the conference.

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Importance of Black Turmeric: Rationale by using the Light Scattering technique

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Keywords: Light scattering; Black turmeric; Mueller matrix; Antibacterial activity.

Light interacts with every matter according to the entity's shape, size, and scattering properties. It employs the study of the intensity of scattered light as a function of angular distribution during the investigation of small particulate matter which ranges from nanometer to micrometre scale. Our present work is based on the investigation of black turmeric (*Curcuma caesia).* Black turmeric is a perennial herb with a bluish-black rhizome. It is a miracle herb with the highest curcumin content and has high medicinal value. Initially, the antimicrobial activity of black turmeric was carried out by using Agar well diffusion method. The antibacterial activity of black turmeric was confirmed by biochemical methods and also validated by the light scattering technique. The observations of the activity were also made at different temperatures. Light scattering investigation of the samples was carried out by using a designed and fabricated He-Ne laser-based light scattering set-up, which uses an incident probe wavelength of 632.8 nm. The scattered light intensity was obtained for different angles over an angular range of 10^{o} to 170^{o}. The scattering profiles usually provide information on the size and shape of the scatterer by working out the Mueller matrix elements. The changes in morphology pertaining to antibacterial action, which was confirmed by biochemical methods, were also recorded by light scattering investigations. The changes in scattering profiles of the black turmeric samples with and without the antibacterial action were noted at different temperatures. The scattering profiles of these samples have revealed the uniqueness of each profile, which ensures the use of a light scattering tool as an alternate means of studying the health benefits of back turmeric without involving biochemical methods, which is actually an invasive method. On the other hand, light scattering is a non-invasive and non-destructive technique that has been proven to be an efficient tool for different types of characterization of biological or organic samples. In our present work, the antimicrobial activity and health importance of black turmeric were confirmed by light scattering signatures for the first time. The detailed analysis and results will be presented during the conference.

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Biodiesel properties of nano-scale lipid droplets produced in microalgae under stress

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When exposed to stress, microalgae produce excess lipids as reserve sources of energy in nano-meter/micro-meter sized organelles called lipid droplets (LDs). Lipids form an important, sustainable third generation biodiesel which are produced during microalgal growth by fixing atmospheric carbon dioxide. The formation, morphology, and composition of these lipid droplets are important parameters which need to be analysed at the single cell level for rapid optimization of conditions giving enhanced biofuel yield. We studied several parameters at the single cell level after subjecting the microalgae *C. reinhardtii* to various stress conditions. High oxidative stress in some stress conditions results in liquid–liquid phase separation (LLPS) of lipids from the cytosol, forming LDs for cellular redox maintenance. The LD-cytosol phase coexistence boundary for single-stage (stress applied on first day of growth) reveals complete LD demixing from cytosol above a saturated volume fraction (φ_{sat}) due to LD growth. If the stress is applied in a gradient mode, LDs are small and dispersed in the cytosol. These differences in LD size and density are attributed to the cell's proteome and thermodynamic factors [1]. The LD composition is analysed with the help of single cell micro-Raman spectroscopy and FTIR, the degree of unsaturation is studied. This enables the calculation of various biofuel parameters. In addition to degree of unsaturation heterogeneities in lipids, micro-Raman spectroscopy also captures varying compositional heterogeneity in carotenoids produced [2]. This is crucial in light of the fact that carotenoids play an important role in lipid formation and cellular redox maintenance under stress. Well-maintained chlorophyll-carotenoid cooperativity is observed from the correlations of Raman intensity of these pigments. This correlation coefficient can be a good marker for detecting the optimum stress allowing stable photosynthesis, good microalgal growth for better biomass yield, relevant for industrial scale microalgal biodiesel production.

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Cellulose based reusable amino acid catalysts: towards green catalysis in organocatalysed reactions

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Strategies to synthesize heterogeneous organocatalysts have gained importance recently due to their advantages, such as the ready separation of products and the reusability of catalysts, which are very important in large-scale production. Inorganic and polymeric supports have been used for immobilization of the catalysts in most cases [1-3].[i]

Biopolymers, such as cellulose and chitosan being cheap and widely abundant in nature, have attracted great interest as supports for catalysts in recent years. In this context, cellulose nanocrystals (CNCs) hold a lot of promise due to their small, uniform size, high crystalline order and chirality; making them classical resource for chiral induction [4].[ii] However, the advantages of cellulose nanocrystals have not been utilized yet in asymmetric organocatalysis.

In this work, synthesis of cellulose and nanocrystalline cellulose supported heterogeneous organocatalysts are reported. As amino acids are versatile catalysts for covalent organocatalysis, cellulose and CNC-supported catalysts derived from a range of amino acids are discussed. Initial trials for catalytic aldol reaction have been performed with ester linked cellulose and glycine (Cell-OCO-Gly) as the catalyst. Though the reaction was sluggish as compared to the reaction with free catalyst, formation of the aldol product is encouraging for further optimization of the reaction conditions.

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Nanoglycocluster based portable diagnostic platform for colorimetric detection of bacteria

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Nanoglycoclusters, an upcoming class of functional nanomaterial are known to drive various processes like detection, imaging, targeting proteins, cells, and bacteria. Nanoglycoclusters are a type of nanomaterial functionalized with various glycans. The array of glycan in multiple copies enhances binding affinity with proteins. Selective and sensitive bacteria/lectin interactions using nanomaterials are an emerging area of research. The measurement of different ligand receptor interactions requires sophisticated analytical tools that limit the application in biosensor domain. Recently, colorimetric biosensors gained importance in the field of the biosensor for the detection of bacteria/lectins. Herein we have demonstrated that different size of gold nanoparticles (AuNPs) along with various polyethylene glycol (PEG) linkers, functionalized with synthesized monopod and tripod of mannose and galactose that have different bacteria/lectins specificity. The newly synthesized nanoglycoclusters were able to discriminate between different lectins and bacteria. The aggregation of specific nanoglycocluster upon interaction with specific bacteria/lectins revealed that mannose monopod (MM) and mannose tripod (MT) are specific to Escherichia coli and concanavalin A (ConA) lectin , while galactose monopod (GM) and galactose tripod (GT) are specific to Pseudomonas aeruginosa and Peanut agglutinin (PNA) lectin. Further, the binding events depict the affinity of tripod glycans is more with respect to its corresponding monopod glycans. Our findings explored the potential of colorimetric sensing depending upon the size of AuNPs, linker length, specificity, along with glycans density to develop user friendly diagnostic system for the detection of bacteria.

Recycling Waste to Fabricate Innovative Hybrid Material

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The development of hybrid material ingrained with graphene is to create a composite material that combines the benefits of both wood and plastic and also incorporating the unique properties of graphene. Graphene is successfully synthesized by hummers' method. Fabricated graphene was analyzed by different characterization tools & techniques viz., Ultraviolet-visible spectroscopy (UV-vis), Fourier transforms infrared spectroscopy (FTIR), X-ray diffraction analysis (XRD), and Scanning electron microscopy (SEM). graphene sheets which appeared as similar thin sheets randomly aggregated, with distinct edges, wrinkled surfaces, and folding clarified by SEM image. X-ray diffraction (XRD) data were analysed and the average diameter of fabricated graphene was found to be 22.03 nm. Graphene ingrained hybrid material (GIHM) manufactured from sawdust and recycled plastics. The surface morphology of GIHM is analysed by Scanning electron microscopy (SEM). Graphene has high tensile strength and stiffness, which can enhance the mechanical properties of graphene ingrained hybrid material, such as tensile strength, flexural strength, and impact resistance which is characterized by Thermogravimetric Analysis (TGA) and Dynamic Mechanical Analysis (DMA).

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Spectroscopic and *in Silico* approach to study the interaction of Gut metabolite; Trimethylamine Oxide with Bovine Serum Albumin

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Trimethylamine N-oxide (TMAO); a gut microbiota derived metabolite has been involved in human health and diseases. The primary mechanism through which TMAOs promotes disease is not clear yet. The binding interactions among TMAO and bovine serum albumin (BSA) were investigated using spectroscopic methods like UV-Vis, photo-luminescence, Fourier transform infrared and circular dichroism. Hydrophilicity/Hydrophobicity of the conjugate was monitored by using contact angle (Ɵ) measurement. Sodium dodecyl sulphate polyacryl amide gel electrophoresis (SDS-PAGE) confirmed the different ratio of conjugate formation with the help of band size. UV-Vis absorbance spectroscopy indicated the absorbance quenching of BSA with the increasing concentration of TMAO which could mainly be due to TMAO-BSA conjugate formation. The decrease in intensity of fluorescence is mainly due to involvement of tryptophan during the conjugation. The occurrence of static quenching was confirmed through Stern–Volmer (SV) plot, which consider the complex formation. *In silico* studies also showed TMAO is involved in non-covalent interaction mainly hydrogen bonding and electrostatic interaction with bovine serum albumin forming stable docking complex with binding score of -3.6 kcal/mol. This kind of interaction study may be helpful in making strategies to break the conjugation between serum albumin and uremic toxin and pave the way for the treatment for CKD and other diseases wherein TMAO is implicated. Also, conjugation of TMAO and BSA studied here may also serve as premise to develop aptamers for the detection of TMAO in the body fluids. The link of TMAO with various diseases such as diabetes, renal and cardiovascular disease, thus aptamer against TMAO could be helpful in early diagnosis of the diseases related to it.

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Development of Dendritic Cell derived Nanosomes as a Vaccine Discovery Platform against Tuberculosis

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A vast reservoir of latently infected TB (LTB) individuals poses a major threat to public health worldwide. Therefore, it is highly significant to explore the development of prophylactic and therapeutic TB vaccines that can protect already infected individuals against endogenous reactivation or infection of TB. So, in this regard, we are developing a TB antigen-pulsed dendritic cell-derived exosomes as a vaccine priming system to induce augmented adaptive immunity. We have successfully isolated exosomes from immunodominant Rv2626 antigen pulsed DC-2.4 cells by differential centrifugation method. The physical characterization of exosomes was carried out by SEM and DLS, demonstrating the morphology and size (& 200nm). We have also characterized the exosome & molecular markers (CD9 and CD81) by western blotting. Furthermore, Antigen-specific adaptive immune responses were analyzed by priming the mice via subcutaneous route with antigen-pulsed exosomes, only exosomes and antigen alone. Antigen pulsed exosomes exhibited enhanced polyfunctional T-cells such as IL-2 and IFN-γ producing CD^{4+} and CD^{8+} T-cell responses compared to antigen alone. Moreover, we have observed heightened antigen-specific total IgG response in the mice group those were primed with antigen-pulsed exosomes indicating active B-cell response. The above observation suggests the priming potential of antigen-pulsed dendritic cell-derived exosomes for improved adaptive immunity against TB antigen-Rv2626 and further provides a platform for nano-vaccine development against TB and other emerging diseases that pose threat to human health.

Comparative Study of Thermophysical Properties of Low-Grade Phases Change Materials with Nano Additives-Based Phase Change Materials

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Energy storage is essential for conserving available energy and trying to maximize usage. Thermal storage can be effectively stored through phase change materials (PCMs) and latent heat storage (LHS) "[1-3]". As a result, the LHS method demonstrated substantially higher energy storage and a small temperature differential between heat storage and its release. From last decade Researchers worked with several phase change materials for thermal energy storage, but obtained insignificant results due to low thermophysical properties "[4-5]". In this experimental study, a comparison has been done among pure stearic acid as a phase change material, 0.1% volume fraction of aluminum

Oxide (Al_2O_3) and copper oxide (CuO) nanoparticles based stearic acid. It is found that liquid thermal conductivity of 0.1% volume fraction of Al_2O_3 and CuO nanoparticles based stearic acid had increased by 16.6% and 26.8%, respectively with pure stearic acid. It was also observed that a tremendous enhancement in the thermo-physical properties of stearic acid by mixing MWCNT additives. It has been established that a heat capacity (solid-state) of 0.02% MWCNT based stearic acid was increased by 25.86% than pure stearic acid. Thus, nano additives based stearic acid are applicable in thermal storage system.

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Metal Catalyzed Chemical Etching (MCCE) of silicon wafer

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Abstract: One of the most critical steps in making a solar cell is texturization be it mono crystalline or multi crystalline silicon wafer. Texturing is a surface modification technique which reduces reflection from the surface of silicon wafer and improve light trapping. Mono crystalline wafers are texturized in basic solution while multicrystalline wafers are texturized in acidic solution. At BHEL ASSCP we are developing universal texturization technique for texturization of mc-Si/ mono-Si wafers which is known as Metal catalyzed chemical etching (MCCE). MCCE is a process that is universally applied to both mono and multi crystalline silicon wafers alike and is found to reduce the reflectance in both kind of wafers. MCCE utilizes a small amount of nano sized $AgNO_3$ solution that works as shading and it causes formation of nano structures on the silicon surface in stage 1 of MCCE process. However, these nano structures are very sharp and it is not possible to successfully do diffusion on these wafer surfaces as chances of puncturing the p/n junction occurs. The reflectance after stage 1 is drastically low as the wafer appear to be black after stage 1 MCCE process. However, because of difficulty to perform diffusion of stage 1 treated wafers, a stage 2 is done, which make the surface less sharp and make it easier for diffusion to occur. In stage 3 cleaning of silver nano particles are done.

Tuning of the Structural, Morphological and Dielectric properties of the Yb_2NiMnO_6 double Perovskite by Ca doping

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The effect of replacing ytterbium with calcium in A site of the Yb_2NiMnO_6 perovskite on Structural Dielectric and Morphological was examined in this study. Solid state reaction mechanism was applied for the synthesis of materials. X-Ray diffraction was adopted to determine the phase of the samples that revealed the orthorhombic structure with pnma space group as verified by the Rietveld refinement. Scanning electron microscope images of the samples show reduction in grain size after doping with Ca^{+2} ions. The grain size and grain boundaries play a vital role on temperature and frequency dependence of the dielectric properties. A huge enhancement in dielectric constant accompanied with diminished dielectric loss was found by increasing the concentration of dopant. Thus improvement in dielectric properties indicates that samples can be used in high frequency applications.

Fluoride Ion Detection Using a Coupled System of Au Nanoparticles and Eu^{3+}

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The design of fluoride ion sensors is an active area of investigation because of its high toxicity and widespread availability [1]. A number of commercially developed methods are available for fluoride ion sensing however these methods have limitations such as requirement of complex instrumentation, well-equipped laboratories and trained personnel. To overcome this, optical methods are emerging as an alternate [1]. The method has advantages of low cost, high sensitivity, low detection limit, ease of handling, and real-time detection. AuNPs are of particular interest because of its bright colour, surface plasmon band, and ability to couple with other functional group making it a great material in sensing application. In our present work we have developed a new method for fluoride ion detection using a coupled system of AuNPs and Eu^{3+} ions. Trisodium Citrate (TSC) and mercaptopropionic acid (MPA) functionalized AuNPs were synthesized by varying the concentrations of MPA. It was observed that the presence of TSC is necessary for the formation of NPs. TEM was taken to monitor the size of the particles and it was observed that at low concentration of MPA, the particles have lower extinction coefficient as well as smaller size. Figure 1 shows the steady state absorption spectra of AuNPs, AuNPs/Eu^{3+} and AuNPs/Eu^{3+}/F^- ions. It is interesting to observe from Figure 1 that no major change in absorption spectra was observed on addition of Eu^{3+} ions to AuNPs however, a decrement in absorption intensity was observed on addition of F^- ions. This can also be visualized by looking at the

precipitate formed on addition of F^- ions to AuNPs/Eu^{3+} solution. Experiments with other competing ions suggest that the probe is selective in nature.

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Atomistic simulations on the dissociation of a screw dislocation in BCC

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Mechanical behavior of materials drastically changes while scaling down to the nanoscale from the macroscale. Large surface energies due to higher surface to volume ratios at the nanoscale can be reasoned for this. Understanding the mechanical behavior of materials at the nanoscale can lead to better design performance. Dislocations play a crucial role in plastic deformation. The behavior of the dislocations can vary with size. In the present investigation, we studied the characteristics of three-fold dissociation of a screw dislocation in BCC-Fe. Molecular dynamics code LAMMPS [1] with the Mendelev et al. [2] EAM potential of Fe was used for atomistic simulations. All simulations were run in the microcanonical ensemble NVT with a time step of 1 fs. A screw dislocation along the Z-direction with different lengths (*L)* and diamters (*D)* ranging from 3 nm to 40 nm was created in a cylindrical nanowire oriented along X=[$\bar{1}$01], Y=[121] and Z=[1$\bar{1}$1] directions. Tensile load was applied alog Z-direction with a strain rate of 10^8 /s. The three-fold dissociation on three co-zonal {110} planes with the trailing stacking faults was noticed. The screw dislocation was not stable in the model system if the value of $D \leq 2$ nm due to the image forces arising from the surfaces. Stress required for the three-fold dissociation was independent of the size of nanowires. However, the screw dislocation was deformed by forming a dislocation loop instead of a three-fold dissociation when system $L \geq 40$ nm. This is due to larger line tension stored in the dislocation line.

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Structural and spectroscopic analysis of Dy^{3+} doped ZrO_2

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The three phases of zirconia: monoclinic, tetragonal, and cubic are significant ceramic materials. The remarkable optical characteristics of the rare-earth-doped zirconia materials have led to their widespread application such as in solid-state lighting. In contrast to traditional lighting sources like halogen lamps and compact fluorescent lights, solid-state lighting uses less energy and has just improved the lighting market [1]. Currently, there are several applications for phosphor-converted LEDs in automobile illumination and interior and outdoor lighting [2]. The solution combustion process was employed to produce powders of ZrO_2 and ZrO_2:Dy^{3+} at different molar concentrations of Dy^{3+} ions. The synthesized series was characterized structurally using XRD, vibrationally using FTIR, and optically using PL, and UV-Vis spectroscopy. The tetragonal crystal structure was obtained in the XRD pattern. The presence of metal-oxygen bonding in the synthesized material was evident through FTIR analysis. The Zr-O vibration mode of the t-ZrO_2 phase was present, as per FTIR spectra. The Dexter energy transfer formula was utilized to investigate the mechanisms underlying the concentration quenching phenomena observed in the PL result.

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Co-encapsulation of multivitamins in micro & nano-sized starch, target release, capsule characterization and interaction studies

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This study was carried out to protect the vital vitamins like D, E, B1 and B2 via encapsulation in micro and nanoparticles of starch from water chestnut. The encapsulation efficiency, particle size, thermal properties and molecular configuration & interactions were studied. The encapsulation efficiencies of nano-sized starch (365nm) was higher than micro sized starch (3.67µm) for vitamin D, E, B_1 and B_2, which was found to be 35%, 81.17%, 83.13%, & 76.07% and 46.27%, 89.29%, 84.91%, & 77.60% respectively. Fluorescence showed higher intensity and non-covalent interactions within the internal matrix of capsules. The FTIR peak at 877cm^{-1} belonging to vitamin ring structures was prominent and confirmed the presence of vitamins in encapsulated powders. The nano starch capsules showed better thermal stability and low crystallinity than micro starch capsules of vitamins. The study suggests the use of co-encapsulated vitamins in food fortification/supplementation to overcome the issues related to vitamin deficiencies.

Bioinspired Peptide Scaffolds for Applications in Healthcare

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The self-assembling peptides are emerging as interesting candidates for the development of scaffolds for applications in tissue engineering. In this context, several structural and functional proteins are identified in biology, which can play a major role in the structural integrity of the extracellular matrix (ECM). Considering the importance of ECM in tissue engineering, the development of these matrices is highly essential for in-depth understanding of cellular microenvironment but there are some challenges in mimicking the complete ECM microenvironments via peptide-based biomaterials. In this direction, peptides-sugar based complex biomaterials have started gaining importance for achieving the structural hierarchy and biofunctional complexity of the native ECM. In our work, we aim to develop an advanced biomimetic scaffold by employing Cardin-motif binding based minimalistic peptide sequence and heparin interactions at the molecular level. Interestingly, it has been observed that the Cardin-motif peptide formed hydrogel at physiological pH after the addition of heparin. It is worth mentioning that the addition of heparin has modulated the supramolecular structure of the peptide and the mechanical strength of the scaffold. Additionally, the interaction between heparin and Cardin-motif peptide demonstrated superior bioactivity and it displayed a crucial role in cellular proliferation and adhesion. To this end, we have also explored a new class of conjugated hydrogel based on carbohydrate polymer consisting of biomass derived nanocellulose and peptides. Interestingly, this conjugated hydrogel was constructed by non-covalent interactions. These intermolecular interactions helped to form unique biomolecular matrix with variable physical properties like mechanical stiffness and porosity etc. This tunable porous network structure presenting a scaffold that offers a superior replica of the native ECM by combing peptide and sugar leading to significant cellular adhesion and proliferation. These multicomponent supramolecular assemblies inspired from natural biomacromolecules may open up a new avenue to fabricate advanced functional materials for tissue regeneration.

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Femtosecond laser assisted fabrication of micro/nanostructures to mimic in vivo like microenvironment

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Micro and nanostructures of tissues and surrounding extracellular matrix play an important role in regulating cellular behavior and fate. However, the conventionally used platforms for in vitro cell studies such as plastic tissue culture plates are devoid of such features and thus, do not mimic the

required microenvironment and lacks the cellular organization, emphasizing the need for substrates with such micro/nanostructures. Several techniques have been reported in the last few decades for the fabrication of such micro and nanostructures but have shown low reproducibility, limited resolution and difficulties in fabricating intricate structures. Femtosecond (fs) laser-assisted fabrication has emerged as a promising technique for the fabrication of complex 2D and 3D micro and nano structures with resolution beyond the diffraction limit and has the potential to overcome the aforementioned challenges 1, 2. In this study, a biopolymer is optimized for fs laser-assisted fabrication and micro/nanostructures were fabricated. The optimized process parameters have been utilized for the fabrication of grooves with varying periodicities in nano to micro scale. These structures have been characterized by optical microscopy and scanning electron microscopy and used as a substrate that mimics the microenvironment for in vitro stem cell culture to study cellular adhesion, proliferation and differentiation stimulated via mechanotransduction. Thus, have potential applications in field of tissue engineering and regenerative medicine.

Keywords: Femtosecond laser, micro/nanostructures, stem cells, microenvironment, regenerative medicine

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Synthesis and characterization of $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_{0.x}O_{3-\delta}$ based composite cathodes for IT-SOFCs

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Keywords: solid oxide fuel cells, cathode materials, electrolyte, conductivity.

Decreasing SOFCs working temperature to 500^{o}C–700°C is a primary concern for current fuel cell research.[1-3] Unfortunately decrease in operating temperatures lead to increase in cathode polarization, which deteriorates electrochemical activity of the cathode for oxygen reduction reaction. Therefore, exploring novel cathode materials is one of the critical bottle necks towards the development of IT-SOFCs. A perovskite oxide $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ - $Gd_{0.}Ce_{0.9}O_{2-\ \delta}$ has been investigated as a novel cathode for intermediate-temperature solid oxide fuel cells (IT-SOFCs). $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ was synthesized by solid state reaction method, by varying x from 0 to 0.10. The phase purity of as prepared $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ powders was evaluated by powder X-ray diffraction with Cu-K_α radiation. No additional phases and peak shifts were detected, which confirms phase purity of the

prepared all the $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$. Rietveld refinement was performed on all as prepared cathodes. The calculated lattice parameter *a* and cell volume *V* are found to vary from 0.3941 *nm* to 0.3960 *nm* and 61.4 $Å^3$ to 62.1 $Å^3$ respectively. The reliability factors 2 to 4 indicate that the refinement results are reasonable and all the $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ oxides shows the cubic structure with space group $Pm\bar{3}m$. Scanning electron microscopy (SEM) was performed to analyse surface morphology. Electrochemical Impedance spectra (EIS) from room temperature (RT) to 600°C confirms enhancement of the electrochemical performance of BSFC cathode materials. The detailed investigation results will be presented at the conference.

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Hybrid Mode Optical Sensor for Gentamicin Detection using Graphene Quantum Dots and Gold Nanoparticles: A Inner Filter Effect Sensing Mechanism

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Keywords: Dual mode sensor, Colorimetric, Fluorometric, Gentamicin, Food Samples

Antibiotics are a life-saving drug for society, but due to the rampant use of antibiotics in human and animal food production sectors developed, antibacterial resistance (ABR) [1] . Due to ABR, typical bacterial infection can be caused to treatment failure or even death. So, it is necessary to detect traces of antibiotics to reduce their consequences to public health. In this study, the detection of gentamicin (GENTA) is done by adopting the fluorometric and colorimetric dual mode sensor by adopting the inner filter effect (IFE) sensing phenomenon [2] . Here, graphene quantum dots (GQDs) served as fluorometric donors and gold nanoparticles (AuNPs) as the acceptor for the development of the acceptor-donor pair. In colorimetric readout mode, the color of AuNPs turned blue from red in addition to GENTA concentration varying as 1.03 -16.55 μM and can be detected the lower concentration of GENTA up to 0.422 μM. In the case of fluorometric readout mode, AuNPs presence quenched the fluorescence intensity of GQDs due to the IFE of AuNPs. In addition to GENTA, AuNPs color turned blue from red and eliminated the IEF of AuNPs, enhancing the fluorescence

intensity of the GQDs-AuNPs pair. The fluorometric readout mode can detect the presence of GENTA upto 0.493 µM. The validation of the sensor was done with spiked milk and egg samples and it was found that the system has capability to detect the residue of GENTA present in milk and egg samples and can be used in food monitoring applications.

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Profile: Reena Sajwan is a Ph.D Scholar at the Special Centre of Nanoscience, Jawaharlal Nehru University, New Delhi, India. Her research focuses on developing nanomaterials-based optical sensors to detect antibiotics in animal-derived food samples. She has published 12 research articles.

Flexible screen printed immunosensor for electrochemical detection of Neuron specific enolase – A lung disease biomarker

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Keywords: Neuron Specific Enolase (NSE), PMF, AFM, EQCM

Neuron-specific enolase (NSE) is a putative serum marker for SCLC with the normal range of 15 ng mL^{-1} in healthy adult's serum, and elevates up to around 25 ng mL^{-1} in patients with SCLC. [1] [2] Moreover it has been recognized as a potential clinical marker for Covid-19 because coronavirus primarily targets human respiratory and neurological system. [3] Electrochemical techniques in conjugation with immunosensor are of great interest for detection of NSE due to its potential efficacy as specific, simple, label free rapid analysis as well as point care detection (POCT). [4] Despite of substantial advancements, the substrate modification procedure is still laborious and challenging. In this context, we have explored a porous organic polymer Polymelamine formaldehyde (PMF) as an efficient substrate material on paper-based screen-printed electrode for label free detection of NSE. The purposed immunosensor has achieved the wide detection range of 120 fM-70 nM (9.4 pg/ml - 5.5 µg/ml) with tail on orientation of antibodies without the assistance of any coupling as well as blocking agent for early diagnosis of small cell lung cancer.

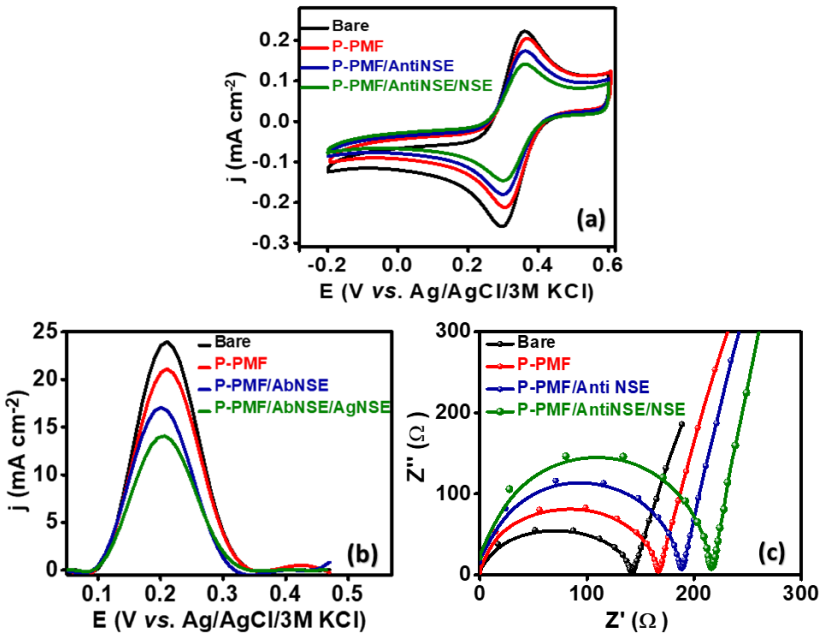

Figure1.(a) Cyclic voltammograms, (b) corresponding SWV and (c) EIS of various PMF modified electrode in 0.1 M PBS solution containing 5 mM of Fe 3+/ Fe 2+ solution.

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The Basics of Photostrictive Effect and its Applications

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Keywords: Photostrictive effect, Wireless, Actuators, Micro-optomechanical systems.

Photostriction is a fascinating phenomenon that offers the direct conversion of light into mechanical strain (Fig.), and enables a facile and a comprehensive approach to realize the compact, wireless and remotely controlled micro-optomechanical systems (MOMS). It also provides a great potential to upgrade the existing electric-driven mechanical devices to optomechanical devices by replacing or integrating the electrostrictive, piezoelectric, or magnetostrictive effects. Although this effect dates back to the 1960s, but with the development of emerging characterization techniques and new material systems in the passing decade, it has regained a widespread attention. In this report, we provide a fundamental overview of the photostrictive effect in various materials, such as polar/non-polar semiconductors, organic materials, hybrid pervoskites and ferroelectrics, and their

characterization with various modern states of art microscopic techniques. Finally, the potential applications (Fig. 1) of this effect are introduced and discussed, followed by the possible advances in the material designing and insitu characterizations for significant and practical photostriction yield.

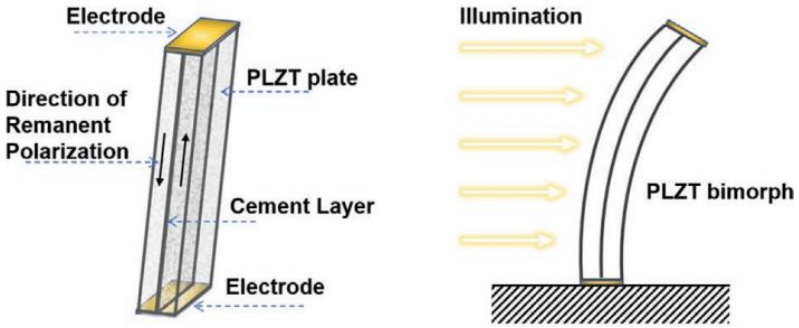

Fig. 1 Schematics of the optomechanical bimorph actuator based on PLZT ceramics[5]

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Muzaffar Ahmad Boda is a Principal Investigator and Post Doctorate Fellow at Shanghai Institute of Ceramics, Chinese Academy of Sciences. His current research focus is photostriction and photocatalytic study of multi-functional materials, such as ferroelastics, ferroelectrics and like.

Role of NiCu co-catalyst in tuning selectivity of CO_2 Photoreduction: A comprehensive study

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Keywords: Co-catalyst, NiCu nanoparticles, Core-Shell structure

CO_2 photoreduction to yield value-added carbon-based fuels is a promising strategy to satisfy the ever-increasing energy demands and also manage the global carbon balance. There are three pivotal processes in photocatalytic CO_2 conversion: (i) solar-light absorption, (ii) charge separation/migration, and (iii) catalytic CO_2 reduction. [1] Boosting charge separation/transfer, improving the activity and selectivity of CO_2 reduction, enhancing the stability of photocatalysts, and suppressing side or back reactions can be achieved by using co-catalysts. [2,3] In this work, we demonstrate the synthesis of Ni and Cu nanoparticles in different weight ratios as co-catalysts and developing heterojunctions with semiconductor TiO_2 to investigate the CO_2 reduction reactions. The morphological, crystalline, band alignment and optical properties of the samples are investigated intensively. Photocatalytic performance is evaluated by measuring the ability of the photocatalysts to convert CO_2 into methanol, CO, CH_4 and other C-C coupling products like ethanol, acetic acid etc. UV assisted photoreduction without any sacrificial reagents are carried out which gives a yield of 333 μmol h^{-1} g^{-1} of methanol and 522 μmol h^{-1} g^{-1} of ethanol. The synergistic effect of Ni and Cu nanoparticles offers difference in yield and selectivity of the products obtained. Microscopic studies reveal that the difference in selectivity owes to the core-shell structure of the co-catalyst and surface etching.

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Nivedhitha T R is a CSIR-Senior Research Fellow, currently pursuing her Ph.D. in Chemistry with Dr. C.S. Gopinath at CSIR- National Chemical Laboratory, Pune. Her Ph.D. thesis mainly focus on Photocatalysis for Chemical Conversion to value added products along with H 2 production. Research also includes cocatalyst-based studies for photocatalytic CO_2 reduction, Water splitting etc.

ADSORPTIVE REMOVAL OF HERBICIDE BENTAZONE FROM WATER USING A NOVEL B-CYCLODEXTRIN CROSS-LINKED POLYVINYL ALCOHOL-CHITOSAN (PVA/CS/B-CD) HYDROGEL OPTIMIZATION USING RSM

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Increasing concentration of pesticides is one of the major problem in the global environment, and it is critical to remove pesticides from the aquatic system. Hence, to resolve this serious problem, a novel β-cyclodextrin cross-linked polyvinyl alcohol-chitosan (PVA/CS/β-CD) hydrogel has been developed for the efficient adsorption of pesticide bentazone (BZ). The surface morphology, surface area, thermal stability and presence of functional groups in the PVA/CS/β-CD hydrogel have been investigated by FESEM, BET, TGA, and FT-IR characterization techniques. The effect of pH, contact time, initial concentration of bentazone, temperature, and mass of hydrogel have been explored by batch adsorption studies and Box Behken Composite Design Model. The adsorption process followed the Langmuir isotherm model with 398.40 mg/g adsorption capacity and pseudo-second-order kinetics model. The BZ adsorption study was thermodynamically spontaneous and endothermic. A recyclability study revealed that the PVA/CS/β-CD hydrogel is readily reusable and still maintains the removal of BZ for six cycles.

Investigation of the structural and photometric properties of SnO_2-incarporated polycarbazole nanocomposite for emissive layer material

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Polycarbazole (PCz) has recently piqued the interest of scientists and researchers for its potential usage in the Flextronics industry owing to its flexibility and chemical stability. The goal of incorporating Tin oxide (SnO_2) into PCz is to increase the photoluminescence intensity. The oxidising agent FeCl 3 was used in the presence of the carbazole monomer and SnO_2 powder to synthesize the PCz/SnO_2 nanocomposite. X-ray diffraction (XRD) and Raman spectra were used to conduct structural and vibrational spectroscopic studies. Morphological and elemental analysis of as-synthesized PCz/SnO_2 nanocomposite was performed using a Field Emission Scanning Electron Microscope (FE-SEM) and an Energy Dispersive X-ray spectrometer (EDX). The photoluminescence intensity of PCz/SnO_2 nanocomposite is increased, indicating that it might be employed as an efficient emissive layer material for optoelectronic devices.

Keywords: Conducting polymer; Nanocomposites; Emissive layer; Optoelectronics

Profile:

Mr. Sanjeev Kumar is pursuing PhD in Physics from IIT(ISM) Dhanbad, India. He is currently working on emissive layer materials for optoelectronic device applications (OLEDs, PLEDs, Organic Solar cells).

GOLD NANO-BIOSENSORS FOR SPATIO-TEMPORAL ANALYSIS OF DNA DAMAGE AND REPAIR

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Biomarker, DNA damage, fluorescent nanoconjugates

DNA damage is involved in the development and progression of several human diseases like cancer[1], therefore it is imperative to maintain its integrity. One of the major challenges to the integrity of DNA is posed by DNA double strand breaks which results during cell cycle. Cells harbour efficient and high-fidelity repair system to restore the DNA sequences, but under stress conditions or defective repair system during which frequency of DNA breaks increases considerably, the fidelity of repair gets compromised resulting in accumulation of mutations. Therefore, it can be argued that frequency of DNA breaks can be used as a surrogate marker for cellular stress, health and fitness. At present, In vivo biomarkers for DNA damage detection remain confined to tagging of DNA repair proteins with fluorescent proteins, which involves either genomic manipulation or insertion of extra chromosomal copies (plasmids). Such biomarkers often compromise the functional activity of repair protein, resulting in low fidelity repair as observed in the case of GFP tagged E. coli RecA protein (RecA-GFP) [2]. Similarly, in eukaryotic system, ɣ-H2AX or RAD51 (human homolog of RecA) are being used as detection marker for DNA breaks [3]. In the present study, we have developed fluorescent gold nanoparticles, which will be conjugated with DNA-binding domain of proteins involved in DNA repair, to study Spatio-temporal dynamics. Our fluorescent nanoconjugates will open up new avenues in studying different biological pathways. Once established in prokaryotic system, these will be further modified for analysis in eukaryotic systems for early disease detection and for development of suitable therapies.

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Microbeads: A Threat for Life on Earth

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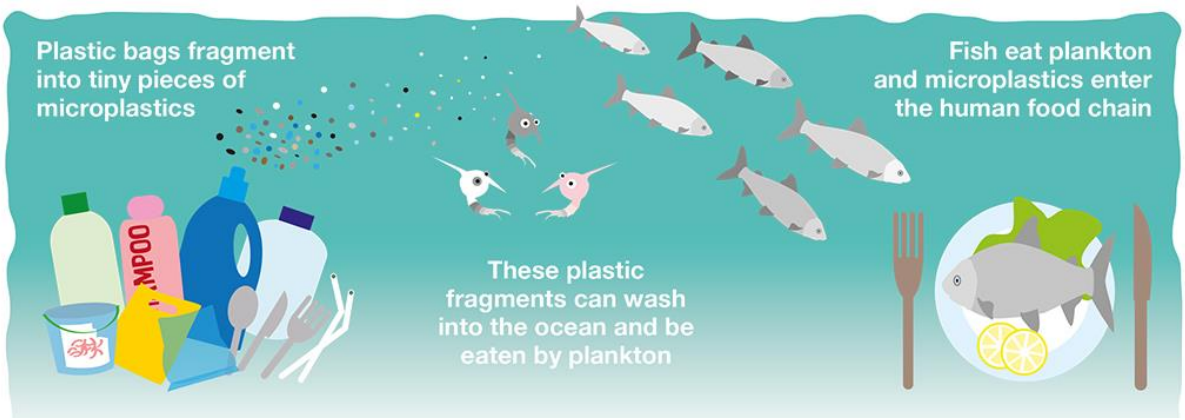
Key Words: Microbeads, PCCP, cleansing products, Plankton, marine life.

Microbeads, the tiny plastic particles used in most of our personal care products are destroying the ecosystem to the point of irremediable. The products like plastic bottles, toothpastes, hand sanitizers, soaps, sunscreen lotions, facial scrubs, body wash, deodorants, shower gel, sunscreens, anti-wrinkle creams, moisturizers, hair sprays, facial masks and cosmetics such as foundation and blush, age-defying, lip gloss and other body care products are full of microbeads. They used generously in these PCCP (personal care cosmetic products) since they are cheap, easily available in abundance. Unknowingly we got used to applying consuming and inhaling the microbeads on a regular basis every day. Microbeads are non-biodegradable, tiny plastic particles that cause a serious threat to the environment, especially marine life. Microbeads have low melting points and can change state from solid to liquid and very fast in hot water only. The 50% of the cleansing products used in our daily life and 70% of the scrubs are found to contain microbeads plastics. These tiny spheres of plastic are penetrated so deep in our lives that only the right information and conscious efforts can bring about fundamental changes for a better future. Like it or not this slow poison is spreading not only in the environment on earth but also in our every once bodies and thus will pass onto coming generations too.

Graphical Abstract: Microbead Cycle



Utilizing Multimodal Data Sources for Water Salinity Prediction

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Keywords: Salinity prediction, geospatial applications, machine learning.

Many daily aspects of our lives, such as, irrigation, household and industrial usage, etc, rely on availability of good quality water. However, common anthropogenic activities such as industrialization, electronic waste disposal, and accidental oil spills in the ocean, and medical waste disposal practices are changing water quality. Salinity is an important parameter affecting water quality, as excessive amounts adversely affect vegetation growth and aquatic organism populations. Natural factors like tidal waves, natural calamities etc., and man-made factors like unchecked disposal of industrial wastes, domestic/urban sewage, and fish hatchery activities can cause significant changes in water salinity. Monitoring the quality of our water sources thus becomes a necessary task. However, measuring salinity in water sources is a tedious, time-consuming and complex process that is conventionally performed through manual surveying and water sample collection, which is often cost-prohibitive. In this article, an approach that utilizes multimodal data like satellite data observations and salinity data for predicting water salinity indices in coastal regions is proposed. Machine learning models such as boosting, bagging, and regression analysis was performed on multimodal data collected from varied sources, and utilized for automated prediction of salinity in regions of interest. Empirical experiments revealed that ensemble supervised learning models outperformed other ML models, emphasizing their suitability for automated assessment of salinity based on multimodal data sources.

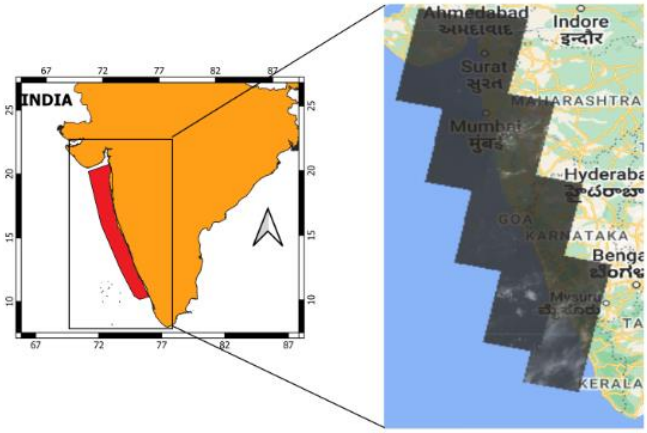

Fig. 1: Area of study – Western coast of India

Profile : Dr. Sowmya Kamath is with the Dept. of Information Technology, National Institute of Technology Karnataka, Surathkal. Her research interests are AI/Machine learning, Big Data Analytics, & Computer Vision. She has published more than 130 articles in reputed journals/conferences in these areas.

Design of chlorin e6 decorated doxorubicin encapsulated chitosan nanogel through ionotropic gelation

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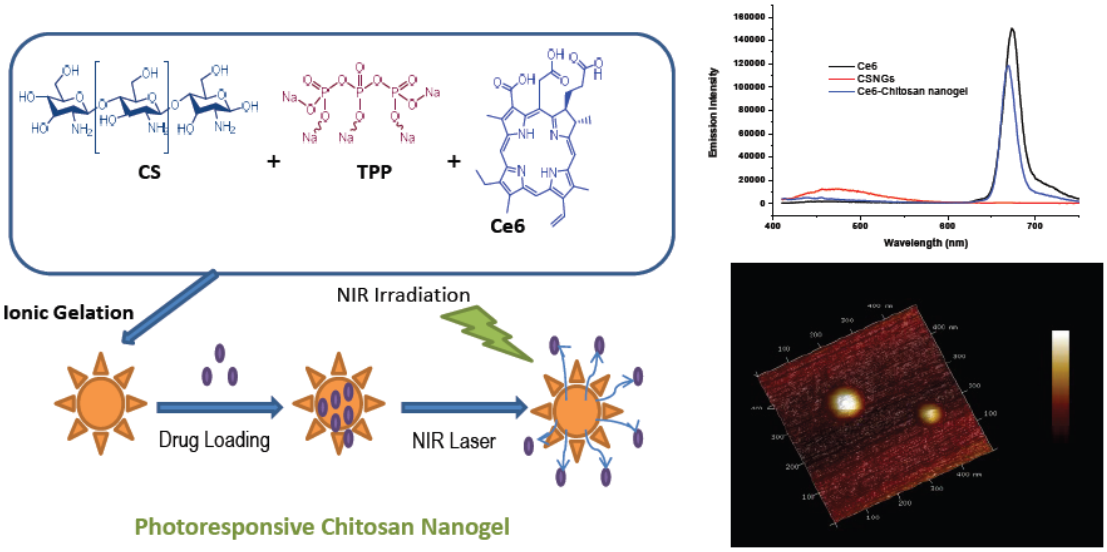
With an objective to improve the photosensitizer efficacy, we have synthesized a chlorin e6 (Ce6) decorated doxorubicin (DOX) chitosan nanogel through ionic gelation technique and have investigated its photophysical and morphological properties under different conditions. The chlorin based sensitizer, Ce6 was encapsulated onto the chitosan nanogel, which in turn was prepared through the self-assembly of low molecular weight chitosan (CS) in the presence of sodium tripolyphosphate (TPP) under aqueous conditions. The physico-chemical and photostability properties of the nanogel as well as the photosensitizer loaded nanogel were characterized by employing UV-visible, fluorescence emission, dynamic light scattering (DLS), scanning electron microscopic (SEM) and atomic absorption microscopic (AFM) techniques.



The absorption spectra of the free Ce6 and decorated with chitosan nanogel were found to be similar, whereas in the fluorescence spectra, we observed enhanced fluorescence intensity for the Ce6 decorated nanogel, when compared to the free Ce6. The morphological studies through SEM and AFM have indicated that the free nanogel exhibited size in the range ca. 80-120 nm with a negative charge of ca 1 to -1 mV, while the Ce6 decorated chitosan nanogel showed ca. 100-120 nm. Furthermore, the Ce6 loaded nanogel showed high photostability, when compared to the free Ce6 and excellent biocompatibility as evaluated by Alamar Blue reduction assay using human skin fibroblast cell lines.

Our results demonstrate that the nano-encapsulation involving hydrophobic interactions significantly enhances the photophysical properties and bioefficacy of the DOX and photosensitizer thereby the potential of the nanogel as an effective vehicle for drug and various sensitizers in Photodynamic therapic (PDT) applications.

Nanoglycocluster based portable diagnostic platform for colorimetric detection of bacteria

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[a]*National Agri Food Biotechnology Institute, Mohali, India*
[b]*CSIR-Central Drug Research Institute, Lucknow, India*

Nanoglycoclusters, an upcoming class of functional nanomaterial are known to drive various processes like detection, imaging, targeting proteins, cells, and bacteria. Nanoglycoclusters are a type of nanomaterial functionalized with various glycans . The array of glycan in multiple copies enhances binding affinity with proteins. Selective and sensitive bacteria/lectin interactions using nanomaterials are an emerging area of research. The measurement of different ligand receptor interactions require sophisticated analytical tools that limit the application in biosensor domain. Recently, colorimetric biosensors gained importance in the field of the biosensor for the detection of bacteria/lectins. Herein we have demonstrated that different size of gold nanoparticles (AuNPs) along with various polyethylene glycol (PEG) linkers, functionalized with synthesized monopod and tripod of mannose and galactose that have different bacteria/lectins specificity. The newly synthesized nanoglycoclusters were able to discriminate between different lectins and bacteria. The aggregation of specific nanoglycocluster upon interaction with specific bacteria/lectins revealed that mannose monopod (MM) and mannose tripod (MT) are specific to Escherichia coli and concanavalin A (ConA) lectin, while galactose monopod (GM) and galactose tripod (GT) are specific to Pseudomonas

aeruginosa and Peanut agglutinin (PNA) lectin. Further, the binding events depict the affinity of tripod glycans is more with respect to its corresponding monopod glycans. Our findings explored the potential of colorimetric sensing depending upon the size of AuNPs, linker length, specificity, along with glycans density to develop user friendly diagnostic system for the detection of bacteria.

Keywords: Gold Nanoparticle, Biosensor, Bacteria, Diagnostic Platform, Colorimetric Sensing.

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Research Associate, National Agri Food Biotechnology Institute, Mohali.
Area of Interest- Biosensor development for bacterial detection.

DMSO-mediated stable aqueous rechargeable iron-sulfur battery for a cheaper energy storage system

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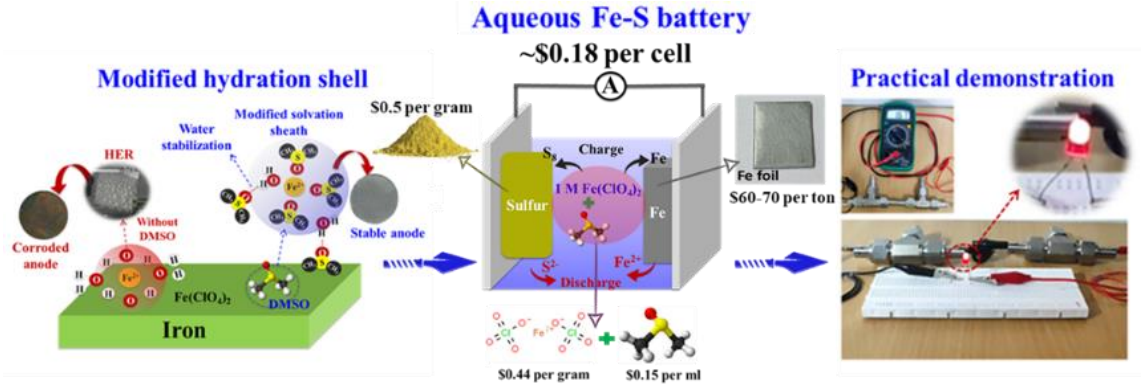
Keywords: Iron-sulfur battery, dimethyl sulfoxide, corrosion studies, HER suppression.

Exploring metal-sulfur batteries with low cost and high capacity has become a hot topic of research. Iron with high abundance and minimal cost provides an excellent option for anode material. [1, 2] However, side reactions in aqueous electrolytes and inherent corrosion tendencies limit their performance. Herein, dimethyl sulfoxide (DMSO) has been investigated as an electrolyte additive to stabilize and limit iron corrosion systematically by FTIR, UV-Vis. and potentiodynamic corrosion studies. Aqueous electrolyte consisting of DMSO as an additive for iron-sulfur battery achieved a high specific capacity of 878 mAh g^{-1} at 0.1 A g^{-1} and maintained the 72% capacity retention at a high current density of 2 A g^{-1} for 150 cycles. The DMSO-mediated stability is attributed to the modified hydration shell around Fe^{2+} ions limiting the hydrogen evolution reaction and the reduced water activity. [3] To the best of our knowledge, there is only one report for rechargeable aqueous Fe-S batteries and this is the first report directed toward stabilizing aqueous Fe-S battery performance using DMSO as an electrolyte additive. This work attempts to explore low-cost methods for stabilizing anode material towards aqueous metal-sulfur systems.



Scheme: Representation of DMSO-mediated stable low-cost aqueous Fe-S battery and its practical demonstration

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Profile of presentator

I Man Singh am a PhD candidate at Indian Institute of Technology Ropar under the supervision of Dr. Tharamani C.N. My research work involves the development of efficient and high energy storage systems.

SINGLE-STEP FABRICATION OF WHISPERING GALLERY MODE RESONATOR FOR BIOSENSING

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Optical microsensors are being widely researched to exploit their extraordinary sensitivity owing to nanoscale properties. Sensing elements like photodiodes, optical fibers, and resonant cavities are of particular interest. Among resonant cavities, Whispering gallery mode (WGM) resonators are optically active micro/nanoscale devices that trap light within their boundary and exhibit ultra-sensitive properties pivotal for sensing and detection applications (Toropov *et al.*, 2021). Two-photon lithography (TPL) is an emerging technique for fabricating micro/nanostructures with high precision and design flexibility. In TPL, a focused laser beam polymerizes a photosensitive resin, creating three-dimensional structures with sub-micron resolution. This enables the fabrication of constructs with tailored geometries and material properties (Jaiswal *et al.*, 2021). Our work demonstrates the realization of functionalized nanomaterial-based fluorescent WGM resonators, including three-dimensional design, fabrication and characterization. Fluorescent WGM resonator-based sensors exhibit high sensitivity, miniaturized design and tunability. Specifically, these resonator-based sensors can be used for label-free detection of various biomolecules, such as viral nanoparticles and other protein molecules crucial towards early diagnosis.

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Two-photon Lithography-assisted 4D Printing of a Miniaturised Organo-arsenic Sensor

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Natural presence of arsenic in soil and water has been expounded with the unchecked industrial effluent discharge. Prolonged exposure to arsenic can lead to severe health concerns ranging from neurological disorders and hyperkeratosis to skin cancer. Hence, there is an urgent need to develop a highly sensitive, selective, cost-effective and a portable sensor for early detection of arsenic. Here, we report the application of a multimodal carbon-quantum dots for 4D printing of a miniaturised sensor using two-photon lithography, for fast detection of organo-arsenic species at ppb level. We have used manganese, nitrogen, and sulphur-doped carbon quantum dots to formulate a two-photon active functional resin for 4D printing of optically active micro/nanostructures, which is sensitive towards organo-arsenic species. The doped-carbon quantum dots initiate two-photon polymerisation in the functional resin, induce emissive attributes to the polymerised micro/nano structures and impart selectivity towards dimethylarsinate ions at the ppb level. The miniaturised sensor shows a change in fluorescence (TURN ON) of the nanostructures when subjected to the analyte. The sensor can detect concentrations of the analyte as low as 1 ppb. This work opens new avenues to exploit the multimodal nanomaterials for 4D printing and development of next-generation miniaturised devices.

Keywords: organo-arsenic detection, nanosensors, femtosecond laser, two-photon lithography, 4D printing.

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$Ni_3V_2O_8$@g-CN nanocomposite based p-n heterojunction: Mechanistic insights on photocatalytic activation of inert C(sp^3)-H bond

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Keywords: Nanocomposite; $Ni_3V_2O_8$@g-CN; p-n Junction; C(sp^3)-H bond activation; Photocatalysis

Selective oxidation of C(sp^3)-H bonds of aliphatic hydrocarbons to form value-added chemicals is still a challenging task being pursued. Herein, a p-n heterojunction based $Ni_3V_2O_8$@g-CN (NVO@g-CN) nanocomposite as a visible light active photocatalyst have been successfully reported for the activation and oxidization of inert C(sp^3)-H bond of cyclohexane under mild reaction conditions. Moreover, p-n heterojunction formed enhances the charge separation at the interface leading to higher photocatalytic activity. Amid all composites, NVO-1@g-CN showed excellent performance towards the production of cyclohexanone with 93.4% selectivity. The plausible photooxidation mechanism was validated by EPR and UV-Vis spectroscopy along with the scavenger experiments. Further mechanistic investigation using techniques like photocurrent density and photoluminescence experiments elucidate that the p-n heterojunction formed at the interface of the catalyst accelerates the charge separation by suppressing the recombination of photogenerated charge carriers. Thus, the p-n heterojunction based NVO@g-CN nanocomposite provides an efficient and sustainable approach for the selective photooxidation of cyclohexane.

Zinc sulfide (ZnS) incorporated polypyrrole (PPy) matrix for high performance supercapacitor

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Keywords: Intrinsic conducting polymer (ICP); Porosity; Cyclic stability

Intrinsic conducting polymers (ICPs) such as polypyrrole (PPy) being possessed superior charge storage capability, high electrical conductivity and high redox activity considered as a suitable material for supercapacitor electrode fabrication. Their electrochemical performance can be further enhanced by incorporating organic fillers such as metal sulfide or oxide. Herein, we have synthesized PPy/ZnS composite *via* in-situ oxidative polymerization method. Morphological studies of the as-synthesized polymeric composite materials were done by using field emission scanning electron microscopy (FESEM) analysis. For structural and elemental analysis, X-ray diffraction (XRD) spectroscopy, Raman spectroscopy, and energy dispersive X-ray (EDX) analysis techniques were employed. The electrochemical performance of the polymeric electrode materials was evaluated with cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS) performed in a three-electrode symmetric system with 1M potassium chloride (KCl) electrolyte.

Dissipative particle dynamics simulation study on emulsion formation by Janus particle

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We present dissipative particle dynamics (DPD) simulation study on the emulsion formation (e.g., oil in water) by using the brush-modified Janus particles. The Janus particle consists of a hydrophobic spherical macroparticle having hydrophilic initiators embedded at one-half of the spherical macroparticle that initiates ATRP (Atom transfer radical polymerization) brush growth. These brush-grafted Janus particles are employed to stabilize the emulsion formation, which shows prolonged stability more than the surface-initiated macroparticle. We perform the comparative analysis of ATRP brush growth on different numbers of macroparticles of different sizes by keeping the macroparticle concentration constant. We first establish the chemical kinetics of polymer brush growth on macroparticles: the monomer conversion and the reaction rates. Further, we explore the effect of ATRP brush length, initiator concentration, and the different numbers of Janus particles on the emulsion formation.

Keywords: DPD Simulation; Phase separation; Janus particle

DETECTION OF *CANDIDA ALBICANS* RESPONSIBLE FOR URINARY TRANSMITTED INFECTION IN REAL SAMPLES USING PEPTIDE-BASED BIOSENSOR

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Infectious diseases posed a serious health threat prior to the discovery of antibiotics and antifungal agents. However, without knowing the microbe responsible, indiscriminate use of drugs resulted in the selection of antibiotic-resistant microbes (Mazel and Davies, 1999). Quick detection and accurate identification of the pathogenic microbe, therefore, is essential. Urinary tract infections (UTIs) are recurring type of infections and need proper diagnosis and treatment. In recent decades, there has been an increase in the percentage of UTIs caused by fungi. *Candida albicans* happens to be the most prevalent of all *Candida spp*. responsible for UTIs. It is essentially important to differentiate between several Candida strains at the species level, for appropriate diagnosis and therapy. We propose to develop a peptide-based biosensors that could quickly detect and identify the microbe. Candidalysin is a secreted peptide toxin released by *Candida albicans* and has a high potential as a diagnostic marker (Moyes et al., 2016). The peptides specific to it, are being identified using molecular docking as well as through phage-display and mirror-phage display techniques. The selected peptide will be immobilised on the bioelectronic electrode surface, using several methods, including deposition or coating the surface with gold nanoparticles, multiwall carbon nanotubes, and reduced graphene oxide.

Keywords: Peptide; Biosensor; Nanotechnology; Candida albicans; Biomarker.

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Interfacial properties of α-synuclein's of Parkinsonian variants

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Keywords: alpha-synuclein; Parkinson's disease; interface; self-assembly; monolayer

Human alpha-synuclein (αS) is associated with the occurrence of Parkinson's disease. In the past decade, six autosomally dominant mutations have been identified in αS (SNCA) gene that translate into A30P, E46K, H50Q, G51D, A53E, and A53T mutations in the protein. These mutations alter the electrostatics and hydrophobicity of a cardinal region of the protein. The interfacial properties of wild-type αS have been reported in the literature (1-3). A comprehensive comparison of interfacial properties of these Parkinsonian αS variants is crucial to understand their membrane dynamics. Here, we investigated the interfacial activity of these αS variants at air-aqueous interface. All the αS variants were found to possess comparable surface activity of ~20-22 mN/m. Compression/expansion isotherms reveal a very distinct behaviour of the A30P variant compared to others. The Blodgett-deposited films were analysed using CD and LD spectroscopy as well as the atomic force microscopy. All the variants adopted predominantly α-helical conformation in these films. Atomic force microscopy of the Langmuir-Blodgett films revealed self-assembly at the interface. The lipid-penetration activity was also investigated using zwitterionic and negatively-charged lipid monolayers.

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Pro-oxidative mimics Cerium oxide nanozyme (CeO_2) as an antibacterial agent

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Bacterial infection causes significant morbidity and mortality, and it has emerged as major threat to public health. Bacteria have the ability to form biofilms, which encase and protect bacteria from harsh environment, making them more challenging to kill. In order to prevent and eliminate biofilms, different methods such as antibiotics, antibacterial peptides, and nanoparticles have been investigated. These antibacterial agents have disadvantages like toxicity, high cost, short term activity, less

efficiency, and low stability. Nanozymes, or artificial enzymes, have several advantages over the other antibacterial agents such as controlled synthesis, low cost, tunable activity, and high efficiency for bacterial killing. Till date, numbers of nanozymes have been investigated as antibacterial agents with their ROS generating potential (pro-oxidative) and achieved a remarkable result. Among them, CeO_2 nanoparticles received attention globally because it offers many advantages such as biocompatibility, low toxicity, high stability and good redox chemistry. In this study, reliable work has been carried out on the synthesis of CeO_2 nanozymes via co-precipitation method. The synthesized nanozymes were characterized by different techniques. Their pro-oxidative potential was investigated along with its effect on bacterial killing. The study found that CeO_2 was having high ROS generating potential as well as good antibacterial activity.

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Effect of $Sm(DBM)_3$phen incorporation methodology on spectroscopic properties of PVA nanofibres.

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Keywords: Electrospinning, samarium complex, nanofibres

Fabrication of electrospun nanofibres is the glittering area of research because of their flexible characteristics and numerous applications in almost all walks of life and technology. Herein, we firstly fabricated lanthanide complex $Sm(DBM)_3Phen$. The synthesised complex was then incorporated into and onto the surface. The detailed study of spectroscopic properties of electrospun nanofibres into and onto the surface is presented. The fabricated nanofibres of $Sm(DBM)_3Phen$ into the nanofibres surface had a diameter had diameter around 200±10nm and length > 200µm and the surface morphology of the complex incorporated nanofibres presented that the nanofibres were smooth and straight and were highly interconnected. The nanofibres with Sm complex onto the surface presented a rough surface morphology. The spectroscopic analysis shows energy transfer from the ligand dibenzoylmethane (DBM) to samarium enhancing its photoluminescence intensity. Under UV excitation the $Sm(DBM)_3Phen$ incorporated nanofibres exhibited narrow bands between 550 and 710 nm and with sharp peaks at approximately 564, 598, 646, and 705 nm, which are assigned to the

transition from $^4G_{5/2}$ to ^6H_J (J = 5/2, 7/2, 9/2, and 11/2) attributed to DBM and Sm^{3+}, respectively. It was observed that the photoluminescence intensity of the two nanofibres varied with the incorporation method. A detailed spectroscopic analysis of the samarium nanofibres with the incorporation methodology is elucidated.

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TUNING OF BAND GAP OF GRAPHITIC CARBON NITRIDE BY METAL DOPING

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Polymeric carbon nitride materials (g-C_3N_4) comprised of carbon, nitrogen and minor content of hydrogen are being widely used as metal-free photocatalyst for the solar light driven applications. The above organic semiconductor provides new selection to employ as photocatalyst mainly due to its low cost, high stability and is based on intrinsic visible light response. However, the low efficiency because of high recombination rate of photogenerated charges restrict the practical use of g- C_3N_4 [1]. Recently, research groups have reported that simple doping can influence the recombination rate by tuning of band gap properties.[2]

Herein, we studied the effect of non-precious transitions metals (Ni, Fe, Co, Zn and Cu) doping on the band gap properties of graphitic carbon nitride. It resulted in the generation of reactions sites suitable for photocatalytic actions. In brief, we have successfully prepared different doped g-C_3N_4 catalyst via simple thermal polymerization at 550^{o}C. The catalysts were characterized.

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Facile synthesis of high quality water soluble CdSe Quantum Dots using hydrothermal process for in-vivo application.

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Keywords: Quantum dots; Hydrothermal process; Bio-molecule; In-*Vivo* application.

Recently, Semiconductor QDs (Quantum Dots) were using in variety of applications covering from optoelectronics to bimolecular applications. Fluorescent colloidal QDs are widely using in most of bio-diagnostic applications. In particular, CdSe QDs are extensively studied because of the fact that their emission can be tunable from blue to red easily by changing its size. In most of successful synthesis CdSe were synthesized via hot injection method where high temperature and organic solvent, TOPO (Trioctylphosphine oxide) as ligands were used which are extremely toxic, explosive or expensive and not suitable for bio-applications. Water soluble high quality QDs are required for bio- applications. CdSe QDs can be synthesised directly in water but they often have wide size distribution result in wide full-width half maxima of emission spectra .However, synthesis of narrow emission, high quality QDs in aqueous environment has its own challenges. The challenge is not only to synthesis high quality QDs but also to make QDs which are active in bio conjugation reaction. Here we want to synthesize tunable narrow emission (Mercaptosuccinic acid) MSA directed water-soluble CdSe QDs without nitrogen bubbling using hydrothermal process for in-vitro applications.

Nickel oxide-based nanostructures loaded on Multiwalled carbon nanotubes for electrochemical energy storage application

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Reversible faradaic processes produce pseudo-capacitance, which is substantially greater than electric double-layer capacitance. Transition metal complexes with numerous oxidation states and ions are promising pseudo-capacitor electrode materials. Nickel-based materials, the most electroactive inorganic materials, are being developed for this purpose. Nickel-based materials have been extensively studied as pseudo-capacitor electrode materials because of their thermal and chemical durability, high theoretical specific capacity, low cost, and environmental friendliness. However, become sluggish due to their low power density, which calls for improvement. The communique addresses the domain of energy storage of hydrothermally fabricated nickel-cobalt oxide nanostructures loaded onto multiwalled carbon nanotubes by analysing the capacitive behaviour of the sample. The high specific surface area due to carbon nanotubes as well as the combined synergistic influence of nickel and cobalt oxides are accountable for the high power and energy density, which makes them instrumental in electrochemical devices.

Key words: Nanocomposites, Electrochemical performance, Power density, nanorods, Supercapacitor

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Fabrication of Sn based 2D materials for next generation device applications

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The field of two-dimensional (2D) materials has seen significant advancements, resulting in increased interest in Layered Metal Dichalcogenides (LMDCs) due to their impressive properties and potential for advanced optoelectronic and photonic applications. However, the cost-effective synthesis of these next-generation energy storage and optoelectronic devices using environmentally friendly materials with the pristine precursors presents a challenge. To address this, we have developed non-conventional fabrication techniques for highly crystalline 2D tin (Sn) chalcogenides, specifically SnSx; x=1,2. These Sn-based 2D materials are abundant on Earth, nontoxic, and environmentally friendly, making them suitable for sustainable electronic applications. SnS_2 being isoelectronic with graphene belongs to the class of 2D LMDs, which also includes WS_2 and MoS_2. Unlike these, both the bulk and single layer of SnS_2 exhibit an indirect band gap. ranging from 2.2 to 2.35 eV. SnS_2 is characterized by unique properties such as high carrier mobility [1], fast photo-response [2], good photocatalytic activity, and high optical absorption [3]. SnS_2 can form lateral or vertical heterostructures with graphene or other 2D materials, offering potential applications in high charge storage capacity, stability, and long-life electrodes for ion batteries [4]. Our primary focus is to synthesize SnS_2 through the implementation of multiple deposition techniques, including physical vapor deposition (PVD), chemical vapor deposition (CVD). Various characterizations were done to study the both physical & chemical properties of the grown film. The methods we have employed for synthesis and our experimental findings may open new avenues and possibilities for utilizing the 2D materials family in optoelectronic and energy storage device applications in the future.

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Photoelectrochemical performance of Titania nanotube array-based photoanode

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TiO_2 is thought to be the best candidate for producing hydrogen through photo-electrochemical water splitting because of its unique properties, such as high photo/chemical stability, non-toxicity, low cost, etc. Its wide bandgap and high electron-hole recombination rate, on the other hand, make it less effective at converting solar radiation into hydrogen (STH). Researchers have put in a lot of work to get the bandgap down to the visible range, but the higher electron-hole recombination rate and lower incident photon-to-electron conversion efficiency (IPCE) are still problems. It has been reported that adding Ti^{3+} species or oxygen vacancies into the TiO_2 lattice has made its photoelectrochemical performance much better in the visible range and improved its electrical and charge transfer properties. The surface oxygen vacancies act both as charge carrier traps and adsorption sites, which prevents photo-generated electron-hole pairs from recombination. However, the bulk oxygen vacancies only act as charge carrier traps and serve as recombination centres for electrons and holes. Herein we report the fabrication of Ti^{3+} self-doped TiO_2 nanotube arrays (TNTAs) via a one-step anodization method subsequently followed by electrochemical reduction. XRD and FESEM were carried out for the structural and morphological examination respectively which confirmed the formation of TNTAs. The absorption spectra showed the absorption edge at about 447nm (visible region) and the corresponding bandgap calculated through the Tauc plot was about 2.77eV.

Objective: This research letter aims to extend the photo-electrochemical ability to visible range, decrease the electron-hole recombination rate by reducing the surface recombination centres and enhance electrical and charge transfer properties.

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Simultaneous TGA-FTIR study of the freshwater bivalve

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The study illustrates the simultaneous thermal analysis of evolved gas products by thermogravimetric analysis (TGA), followed by the analysis of corresponding FTIR spectra and interpretation of the weight loss as water vapour, CO_2, and other potential degradation products are released during the thermal degradation of the freshwater bivalve shell. The study also suggests that the organic matrix does not fully degrade even after two stages of weight loss. The FTIR spectra demonstrate that there

may be an organic functionality present which can be confirmed by the presence of OH/NH modes of vibration.

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FORMULATION, DEVELOPMENT AND CHARACTERIZATION OF ACARBOSEENCAPSULATED GUAR GUM NANOFORMULATION AGAINST TYPE 2 DIABETES

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Diabetes is an emerging epidemic disease with an estimated 425 million people already affected worldwide and the figures are expected to rise up to 629 million till 2045. Acarbose is a competitive inhibitor of αGlucosidase, which exerts hypoglycemic effects by delaying carbohydrate digestion without substantially affecting serum insulin level. However, the clinical application of acarbose is hampered due to its short halflife in the systematic circulation, so the drug requires repetitive administration (3-4 times per day), with doses of 25-100 mg, which further leads to several gastrointestinal side effects like abdominal pain, flatulence and diarrhea. Therefore, there is a need to develop sustained-release formulations for avoiding repetitive administration and reducing gastrointestinal side effects of acarbose by improving its short-half life. In order to address these issues, herein, we developed acarbose-encapsulated guar gum nanoformulation. The acarbose-encapsulated guar gum nanoformulation was synthesized and characterized using spray-dryer, SEM, FTIR, XRD, and HPLC. The developed spray-dried nanoformulation was also evaluated in-vitro to

observe its antioxidant and anti-diabetic potential. In-vitro drug release of the prepared nanoformulations was taken up for determination to evaluate its time-release kinetics. The developed acarbose-encapsulated guar gum nanoformulations exhibit spherical shape under SEM and the peak reduction was observed under XRD examination. The drug loading capacity and encapsulation efficiency of nanoformulations were found to be 89.52%, 80.59%, 72.016% and 64.68%, 78%, 80.94% respectively. Furthermore, the developed nanoformulations were capable to inhibit the free radical generation, and activities of carbohydrate digesting enzymes: α-glucosidase and α-amylase. Therefore, these findings collectively indicated that acarbose-encapsulated guar gum nanoformulations may serve as a promising nanocarrier for improved therapeutic efficacy of acarbose in diabetes.

Keywords: Diabetes; Guar gum; Acarbose; Short-half life; free radical.

Reduced graphene oxide-Gadolinium oxide (rGO@Gd_2O_3) nanocomposite used for the detection of gentamicin electrochemical sensor on Screen-Printed Electrodes

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Keywords: rGO@Gd_2O_3, Screen Printing Electrode, Gentamicin

Aminoglycosidic antibiotic such as gentamicin is used to treat bacterial infections like mastitis and metritis. Escherichia coli, Staphylococcus, Streptococcus and many more are among the pathogens which has broad spectrum activity[1]. Excessive consumption of Gentamicin may result in hearing loss, renal toxicity, and allergies[2], [3]. Conventional techniques are available such as Gas Chromatography (GC), High performance liquid chromatography (HPLC), Mass Spectrometry (MS) etc. for detection of gentamicin, but these are expensive, time consuming and used sophisticated instruments for testing of gentamicin. Hence, simple, in-expensive, rapid and sensitive method is required to resolve the detection issues. As a result, the purpose of the presented work was to design and develop a low-cost, point-of-care device for a quick and accurate detection in order to reduce the time-consuming process and high cost per sample. This was done in order to overcome the difficulties that were mentioned earlier. A paper-based immunosensor has been created and developed for quick detection of gentamicin in this section. Also, this tool would assist farmers and veterinarians in making thoughtful judgements regarding the administration of antibiotics to animals. Herein, Gd_2O_3 used because of unique properties such as semi conductivity, less toxicity and biocompatibility but some issue with Gd_2O_3 has found that as electrode instability, moderate sensitivity and selectivity. Therefore, to overcome this problem integration of carbon compound as a rGO a three-dimensional carbon sheet with Gd_2O_3 to enhance selectivity, sensitivity and stability. Keeping above mentioned, this study is focused on exploring a cost-effective and efficient electrochemical immunosensing platform. rGO@Gd_2O_3 nanocomposite synthesized by chemical synthesis route and further characterization of rGO@Gd_2O_3 nanocomposite was done by X-ray diffraction (XRD), scanning electron microscopy (SEM), and electrochemical techniques. These rGO@Gd_2O_3 NC were dropped cast onto SPE and used for immobilization of antibodies specific to GEN (Anti-GEN). This BSA/Anti-GEN/ rGO@Gd_2O_3 /SPE immunoelectrode exhibits a wide linear detection range (0 pM-100 µM) with a low limit of detection 0.424 pM and sensitivity of 44.87 µA pM^{-1} cm^{-2} with good linearity of $R^2 = 0.981$ against gentamicin and also found good results with the spiked milk samples.

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Tuning Phytomedicine into Photomedicine for Environmental and Healthcare applications: Synthesis and characterization of Quercetin-derived Carbon Nanodots

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Integrating fundamental concepts from biomaterials science and nanotechnology is pivotal for designing smart nanomaterials. In this report, we present the hydrothermal method-driven synthesis of carbon nanodots (CNDs) using quercetin and further evaluated the effects of surface passivation on their physicochemical and biological attributes. qCD is referred to CNDs derived from quercetin and qCD-Pg is referred to CNDs' surface passivated with polyethylene glycol. Firstly, the qCD was employed as a fluorescent nano-probe that can detect Arsenic (As^{3+}) concentrations as low as 0.763 μM through enhancement in fluorescence emission. Further, it was revealed that upon surface fabrication with polyethylene glycol, qCD lost its ability to sense As^{3+} but qCD-Pg was now able to selectively detect Iron (Fe^{3+}) concentrations as low as 0.728 μM. Secondly, Andrographolide (Ad) was conjugated to qCD-Pg and termed as qCD-Pg-Ad, which acted as a nano-carrier via electrostatic interactions. These conjugates prolonged and improved the drug release, leading to an enhanced killing effect on Leukemia cancer cells (K-562). Also, the qCD-Pg-Ad complex had a better anticancer effect on K-562 than free Ad but very low cytotoxicity to normal kidney cells (Vero), indicating specificity of the conjugate to the Leukemia cancer. Further, these CNDs considerably inhibited Multi-Drug Resistant bacterial strains' growth and exhibited significant free radical scavenging potential. These nanodots were also evaluated for thermal stability, colloidal dispersion stability, and photostability. Overall, the findings of our study demonstrated Phytomedicine-derived CNDs as a photomedicine with broad applications in biomedical and environmental domains.

Keywords: Sustainable Development Goal 6, Heavy metals sensing, Nano-probe, Drug delivery, Polyphenolics.

$Bi_2Ga_4O_9$: A non-lanthanide host for luminescent lanthanide ions

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Keywords: Bismuth Gallate, Photoluminescence, Europium Doping, Phosphor.

Abstract: A non-lanthanide based host $Bi_2Ga_4O_9$ with 4% Eu has been prepared with phase purity. PL studies reveals host to Eu^{3+} energy transfer relevant for optoelectronic applications.

Introduction:

An everlasting hunt for acquiring non-lanthanide host for rare earth luminescent center has attracted many researchers. To address this quest the work has been initiated on non-lanthanide bismuth gallate host, since these oxides have been reported properties like large band gap, high oxygen ion conductivity, remarkable photoconductivity and good photoluminescence. (1)

Experimental Details:

Phase pure $Bi_2Ga_4O_9$ with 4% Eu doping was prepared by conventional solid-state method using stoichiometric amount of Ga_2O_3: Eu and Bi_2O_3: Eu and annealing.

Results and Discussion:

XRD patterns of 500°C and 800°C heated samples are shown in Figure 1(a). Whereas the sample annealed at 500°C is amorphous in nature, subsequent heating to 800°C leads to the formation of highly crystalline orthorhombic phase of $Bi_2Ga_4O_9$ with Pbam space group. Emission spectrum of 800°C heated sample show peaks characteristic magnetic and electric dipole transitions of Eu^{3+} ions with later transition being more intense (Figure 1(b)). Corresponding excitation spectrum (Figure 1(c)) show broad peak with maxima around ~310 nm due to the overlapping of Eu-O charge transfer and Bi^{3+} absorption ($^1\mathbf{S_0} \rightarrow {}^3\mathbf{P_1}$ transition) peaks. In addition, sharp peaks due to intra-*4f* transition of Eu^{3+} are also observed. Thus, results reveal the efficient energy transfer from the $Bi_2Ga_4O_9$ host to luminescent Eu^{3+} ions in a broad energy range.

Conclusions:

Non-lanthanide based phase pure $Bi_2Ga_4O_9$ with 4% Eu has been synthesized and phosphor shows suitable photoluminescence behavior for optoelectronic applications.

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ENHANCED THERMAL STABILIZATION OF GALLIUM-DOPED Ge2Sb2Te5 THIN FILMS

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The phase change memories based upon the composition $Ge_2Sb_2Te_5$ (GST) generally exhibit two-step crystallization to store and process data. Also, it is well understood that the actual phase transition occurs between the amorphous and the metastable fcc phase. In this work, the thermally evaporated Ga-doped GST thin films are noted to stabilize the fcc phase for annealing temperature up to 260 °C. The optical transmission contrast confirmed the thermal stabilization of the fcc phase and suppression of the high-temperature hcp phase with thermal annealing. These findings suggest that Ga doping improved the properties of host GST composition, posing it as a potential candidate for phase change memory applications with fast processing speed and low power consumption.

Keywords: Phase change materials; doped GST; optical properties; thermal stability.

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KINETICS OF PHASE-SEPARATION OF POLYMERIC FLUID MELTS Of VARIOUS TOPOLOGIES

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We present the phase-separation kinetics of binary (AB) polymeric fluids using the dissipative particle dynamics (DPD) simulation method in d = 3. Three different polymeric fluid topologies, such as diblock copolymer (BCP), ring block copolymer (RCP), and miktoarm star polymer (MSP), are considered. Initial homogeneously mixed polymeric fluids are quenched to a lower temperature, $T < T_C$, where T_C denotes the critical temperature. We observed that by changing the composition ratios of A and B chain blocks from critical (1:1) to off-critical (1:7), evolution morphologies change from

lamellae to cylindrical in the case of BCP and MSP, whereas in the case of RCP evolution morphologies are different for off-critical cases. To characterize these morphologies, we calculate the radial distribution function, the radius of gyration, domain growth, and the scaling functions.

Keywords: melts; topology; domain growth; scaling.

Formulation, optimization and evaluation of Syringic Acid (SA) loaded guar gum nanoformulation against diabetic wound healing

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The most prevalent illness, diabetes mellitus, is characterized by hyperglycaemia. Chronic hyperglycaemia may cause an excess generation of free radicals, which causes oxidative stress and hinders wound healing. Wound treatment is in high demand and difficult to manage. Thus, improving chronic wound dressings remains a priority. Nanotechnology helps acute and chronic wounds heal faster by promoting proper healing phases. Guar gum-based drug carrier systems are being used to manage and sustain the release of many therapeutic medicines. Guar gum is safe and effective for medication delivery due to its natural occurrence, accessibility, biocompatibility, biodegradability, and mild manufacturing technique.Anti-diabetic and antioxidant activities have been attributed to syringic acid (SA), a naturally occurring phenolic molecule found in many plants mainly fruits. The purpose of this work is to develop nanoparticles of Syringic acid and investigate its hypoglycaemic and wound healing properties. By using the oil in water approach, nanoparticles of guar gum loaded with syringic acid were developed. Utilizing response surface methods (Box-Behnken design),preparation procedure and formulation factors were optimised to produce the lowest particle size and highest encapsulation efficiency. Nanoparticle size (NP), PDI value, zeta potential, entrapment capacity and in vitro drug release was taken for determination of the optimal NP formulation. Based on the data, anoformulation of guar gum with SA was found potential approach for improving wound healing properties of Syringic acid. The findings for particle diameter, PDI, zeta potential, and drug entrapment were around 200 nm, 0.5, -30 millivolts, and 80-90%, respectively. Drug-loaded nanoparticles were found to be biocompatible after cytotoxicity testing on L929 cells. Significant free radical inhibiting properties ((DPPH, ABTS) and antidiabetic properties (α-amylase, α-glucosidase) are also observed in the formulation. Therefore, stabilized nanoformulation could be suitable drug delivery system to enhance the effects of drug loaded guar gum nanoformulation in the treatment of diabetic wound healing.

Keywords: Diabetes, Wound healing, Syringic Acid, nanoformulation, biocompatibility.

Stability and efficiency enhancement in organic solar cells using modified Cobalt (II) acetate as hole transport layer

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Keywords: Cobalt acetate, Hole transport layer, Organic Solar Cells, Stability.

Recently, the power conversion efficiency (PCE) of organic solar cells (OSCs) has significantly progressed with a rapid increase from 10% to 19% due to state-of-the-art research on non-fullerene acceptor (NFAs) molecules and various device processing strategies. Poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT:PSS) and MoO 3 are the most widely used hole transport layer (HTL) in conventional and inverted OSCs, respectively; however, some drawbacks still limit their practical use. In this study, a Cobalt-Powder as HTL material was synthesized by adipic acid with a very simple, low-cost in one step method to replace PEDOT:PSSHTL and utilized in NFA OSCs based on PM6:Y6 active layer. The morphological and optical characteristics of the HTLs were investigated using atomic force microscopy and UV-Vis absorption spectroscopy, respectively. It was found to have excellent hole transport material compared to PEDOT:PSS. The HTL material was also stable under ambient conditions, with no significant degradation over time. Hemraj Dahiya currently works as a research scholar (DST-INSPIRE Fellow) in the Department of Physics at The LNM Institute of information technology (LNMIIT), Jaipur, India. He is mainly working on interfacial layers to resolve the stability issues followed by the fabrication and characterization of efficient BHJ ternary organic solar cells based on non-fullerene acceptors (NFAs)

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Visible light-induced photoreduction of cadmium by biosynthesized ZnO nanoparticles supported on bentonite

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Cadmium is one of the heavy metals shown to be very toxic when present in significant amounts in water. This paper describes an eco-friendly approach for the green synthesis of ZnO-bentonite nanocomposite and how effectively it removes cadmium by photocatalysis when exposed to visible light. Aqueous fruit extract was efficiently used as a reducing agent to synthesize the ZnO nanoparticles. The modification of the band gap of ZnO nanomaterials is critical in fine-tuning of the optical properties of materials. So, in this work, the analysis of band gap modification for ZnO nanoparticles is discussed. As a result, the photo reduction efficiency of ZnO nanoparticle in the visible light area has increased. During catalysis, Cadmium may get adsorbed on ZnO surface which highly decreases efficiency. Hence, we reinforce the ZnO nanoparticles with Bentonite to form ZnO/BT nanocomposites. The cadmium particles get adsorbed onto bentonite instead of ZnO and when photocatalysis occurs, the cadmium is readily available to be reduced by ZnO nanoparticles. Thus, the ZnO/BT nanocomposite becomes more efficient than ZnO nanoparticles. The prepared ZnO/BT nanocomposite is characterised by diffuse reflectance spectroscopy, scanning electron microscopy, Fourier transform Infrared Spectroscopy, X-ray diffraction and Brunauer-Emmett-Teller analysis. Removal efficiency of 80% was obtained for cadmium in a six-hour period under visible light.

Keywords: Photoreduction, nanocomposite, ZnO/BT, cadmium.

Eco-friendly superhydrophobic carnauba wax- modified emulsion template PDMS sorbents for efficient oil-water separation

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Keywords: PDMS sponge, carnauba wax, emulsion casting, water remediation.

Production and transportation activities of crude oil and major oil spilling accidents significantly contribute to deterioration of water quality and thus withdrawing great attention of material scientists to develop efficient sorbent technology for the separation of dispersed oil (20-150 µm) and emulsified oil (20 µm) from water sources [1]. This work deals with the development of novel eco-friendly superhydrophobic emulsion templated natural Carnauba wax modified Polydimethyl siloxane (PDMS) sponges for efficient oil-water separation. A microporous PDMS sponge was developed by emulsion casting technique (with water as the internal phase) on a sacrificial sugar cube template [2]. Study showed that water in PDMS emulsion successfully leads to enhanced porosity and interconnected network that led to significant increase in oil sorption capacity of the PDMS sponges by 3 times as compared to standard sugar leached microporous PDMS sponge. Superhydrophobic nature of the sponges was further enhanced by recrystallizing microcrystalline carnauba wax on the PDMS sponge surface. Surface morphology and pore size of the sponges were investigated by SEM. Analysis of other physio-chemical properties were done by FTIR studies and measurement of water contact angle. Oil absorption capacity of the modified sponges was tested for petrol, diesel, crude oil, and other hydrocarbons. For instance, diesel sorption capacity of these sponges was found to be 1100 - 1200 w/w%.

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Comparative Study of Anti Corrosive Efficiency of Nano Carbon Dot (from fish waste) reinforced commercial epoxy polymers.

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Keywords: Fish skin, Carbon dots, fluorescence, epoxy polymers, corrosion resistance.

India is one of the pioneers in world fishery production, and generate 2 million tons of waste as a part of fish processing. Fish waste is a menace to public and planners, hence it has to be managed efficiently. Collagen is the major portion of fish skin protein, hence it can be utilized for the development of high value products such as nano carbon dots. Since corrosion is a major problem associated with boat building steel BIS 2062 in marine environment, nano carbon dot synthesized from fish skin is analyzed for its application as an additive in epoxy polymer for preventing corrosion. Nano carbon dots were synthesized by hydrothermal carbonization method using tuna skin as the precursor. Fish skin carbon dot (FSCD) thus synthesized were characterized using UV- Visible spectroscopy, fluorescence spectroscopy and TEM analysis, which suggest that FSCD is composed of fluorophores imparting blue green fluorescence. Optimized FSCD reinforcement in three different epoxy polymers and coated over boat building steel BIS2062. Its electrochemical and surface morphological characteristics were evaluated using Linear Sweep Voltammetry (LSV), Electrochemical Impedance Spectroscopy (EIS), Scanning Electron Microscopy (SEM). 0.05% FSCD reinforced Dobekote came up to be the appropriate combination to prevent corrosion with reduced pores, easier to coat, low capacitance, low corrosion current intensity and high polarization resistance. Thus, Fish waste derived CD will be a boon in anticorrosive coating industry as it maintains majority of the requirements to be a better anticorrosive additive to epoxy polymers in economic and ecofriendly way.

In silico characterization and expression profiling reveals the role of barley HSFC2c gene in stress response

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Keywords: Heat shock factors, HvHSFC2c, Abiotic stress, Heat stress response, Barley.

Heat shock factors (HSFs) perform crucial role in initiation and maintenance of heat shock response in plants. Among the three classes of plant HSFs; class A, B, and C, the role of class C genes in stress response and development is not known. Out of total 23 HSF genes of barley, 5 genes belong to class C. We characterized HvHSFC2c gene through in silico analysis and expression profiling for its potential role in vegetative and reproductive development under stress conditions. In barley genome HvHSFC2c gene is located on chromosome number 4; it encodes for a 262 amino acid long, 28.8 kDa protein with a pI value of 5.68. HvHSFC2c protein displays the presence of characteristic HSF domain (DNA binding domain), oligomerization domain and NLS. The promoter analysis revealed the presence of stress, hormone and development related cis- regulatory elements including HSE (heat shock element), DREB, and Myb binding site. In silico analysis as well as transient transformation experiments showed the nuclear localization of HvHSFC2c protein. The expression analysis through qRT-PCR revealed the upregulation of HvHSFC2c gene during abiotic stress exposed vegetative and reproductive development. In vegetative tissue, maximum upregulation was noted under drought stress, among the abiotic stress treatments; which correlated with the highest expression under ABA elicitation, among the chemical treatments. Moreover, the significant upregulation was observed in vegetative tissue during recovery from heat shock as well as in heat stress exposed maturating seeds. These findings suggest that HvHSFC2c gene play major role during plant stress response under water limiting conditions by transcriptional modulation.

Complexation study between corn protein (zein) and phytochemical (geraniol): An approach to deliver phytochemical towards Candida albicans

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Keywords: Zein, Geraniol, Nanocomplexes, Anti-fungal activity.

Colloidal particles of zein are used to encapsulate phytochemicals, such as curcumin, quercetin, essential oils, and various hydrophobic compounds. The present work reports the complexation of zein with an acyclic monoterpenoid alcohol, geraniol found in the essential oils of rose, palmarosa, citronella, etc., which is known to have insecticidal, larvicidal, fungicidal, and anti-microbial properties [1,2]. In this work, a series of zein-geraniol complexes were prepared in a water-ethanol mixture [3]. The complexes were characterized using various experiments, such as UV-Visible spectroscopy, fluorescence spectroscopy, turbidity meter, zeta potential, and light scattering technique. Furthermore, the effect of pH (4, 6, 10) was also observed on the formation of these complexes. It was observed that structurally different nanocomplexes were formed at low and high concentrations of geraniol. A possible hypothesis for the mechanism of interaction between zein and geraniol has been shown in Figure 1.

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Design of colorimetric biosensor for the detection of pathogenic Pseudomonas aeruginosa bacteria

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Bacterial infections are considered to be a serious health problem all over the world. Early detection of infection is very important for effective antibiotic use, which can lessen the harshness of infection and the development of antibiotic resistance. So for the timely detection of bacterial infection here we have developed a paper based coloriometric biosensor for the detection and identification of Pseudomonas aeruginosa bacteria which we can see by our naked eye[2,3]. This sensor array was developed on Nitrocellulose Membrane paper with the help of self standing technique using 10,12-Pentacosadiyonic acid (PCDA) and Cholestane-3β,5α,6β-triol (Cholesterol), followed by Polymerization through UV irradiation[1]. The hectorite clay material was implemented for support to this sensor system to increase the mechanical stability[1]. It has been observed that this sensor array strongly depends on the mixing ratio of PCDA and Cholesterol.it has been found that at 0.1 and 0.4 mole fraction of Cholesterol the interaction was attractive and at all other mole fractions interaction was repulsive in nature and we designed our sensor at 0.4 mole fraction of cholesterol. This sensor was tested on Staphylococcus aureus and Pseudomonas aeruginosa bacteria and has been responded to Pseudomonas aeruginosa bacteria not to Staphylococcus aureus and this responds towards the sensor was mainly due to secondary metabolites that was secreted by bacteria which made changes in the polydiacetylene (PDA) backbone. Hence a biosensor can be developed using PDA and cholesterol in order to sense pathogenic bacteria.

Keywords: Biosensor, Pseudomonas aeruginosa, polydiacetylene.

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Pyrolysis process based CQDs synthesized using different precursor and their application in photocatalytic degradation of Rhodamine B (RhB)

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Keywords: CQDs, Pyrolysis, photocatalytic degradation, RHB.

Citric acid, urea, and polyethyleneimine were used as precursors in the pyrolysis process that we used to synthesize carbon quantum dots. Two samples have been synthesized: CQD-S1, which was synthesized using polyethyleneimine and urea, and CQD-S2, which was synthesized using polyethyleneimine and citric acid. In studies of optical characteristics, two different peaks at 243 nm and 345 nm for CQD-S1 and at 265 nm and 335 nm for CQD-S2 have been found [1]. For CQD-S1 and CQD-S2, the maximum emission in a fluorescence analysis was observed at 340 nm and 350 nm, respectively [1]. Transmission electron microscopy (TEM) morphological investigations showed that the particle sizes of samples CQD-S1 and CQD-S2 were 1.91 nm and 1.61 nm, respectively. For CQD-S1, the Rhodamine B (RhB) dye degradation percentages were reported to be 6, 13, and 98.4%, respectively, in the dark and under visible and UV light. The corresponding dye degradation for CQD-S2 was 7, 11, and 99.63%. Utilizing the mineralization process, photocatalysis that was performed under UV light was effectively degraded in 100 minutes.

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Blue-light excitable Ultra-broad light emitting Ce^{3+}/Cr^{3+} co-doped garnet phosphor for white light emitting device and optical thermometry

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Keywords: Garnet, energy transfer, electroluminescence, and optical thermometry, etc.

Blue light pumped, Ce^{3+} doped garnet structure based phosphors have been used widely for phosphor-coated white light emitting device (pc-WLED) purposes. But WLED prepared with this type of phosphors suffer from low color rendering index (CRI) and higher correlated color temperature (CCT) values owing to the deficiency of red components in its emission spectrum. To overcome this challenge, authors have prepared Ce^{3+}/Cr^{3+} co-doped $Gd_3Al_4GaO_{12}$ garnet phosphor which is capable of emitting ultra-broad (450 nm-850 nm) light emission via utilizing an energy transfer mechanism

from Ce^{3+} to Cr^{3+} under blue light (460 nm) excitation. The crystal structure and phase purity of the prepared sample have been examined using the X-ray diffraction pattern of the sample. The optical studies of the sample have been inspected using diffused reflectance and photoluminescence spectra systematically. Further, the temperature dependent PL spectra were measured to check the thermal stability and thermal response characteristics of the dopants. For the commercial application of the sample, the selected sample was used for fabricating the WLED device by combining it with a blue LED chip (InGaN). The voltage stability of the prepared WLED has been tested by measuring voltage-dependent electroluminescence spectra. Moreover, the CRI and CCT values of the fabricated pc-WLED were measured and it is found that these values are better than some of the already commercially available pc-WLED. In addition to this application, the sample also has been checked for contactless optical thermometry application using the luminescence intensity ratio (LIR) technique. Thus, the prepared phosphor could be used for pc-WLED and contactless optical thermometry purposes.

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Effect of Different Locally available Botanicals on the Silkworm Bombyx mori L . Commercial Cocoon Characteristics infected with Muscardine Disease

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Keywords: Botanicals, Muscardine, Management, Silkworm, Cocoons.

Indian silk has enthralled fashion watchers and all categories of consumers across the world with its vast repertoire of motifs, techniques and brilliant hues. One of the traditional sericulture areas, Jammu and Kashmir is renowned for its high-quality bivoltine silk production. However, compared to the southern states of the nation, cocoon production is modest. Low cocoon yield is attributable to a number of factors, including poor mulberry leaf quality, an absence of enough rearing area and equipment, but disease outbreak is one of the major constraints in attaining high productivity. The disease outbreak hampers the progress; thereby the silk industry often faces a serious setback. White muscardine disease due to Beauveria bassiana causes high mortality with a cocoon yield loss upto 30 percent almost throughout the year. There have been reports of using both botanicals and other chemicals to manage the diseases in helpful insects like silkworms. When chemicals are used to manage the disease, residual toxicity results. The dangers of toxic chemicals used in the management of diseases in humans and animals have made it necessary to conduct research on eco-friendly extracts with natural and biological sources in recent years. Numerous plants have antibacterial properties and are non-toxic, biodegradable, and non-polluting, making them an alternative management method for silkworm diseases. Keeping in view the economic importance of the disease and the present-day strategy (eco-friendly) of disease management, it was seriously thought to study the impact of botanical extracts on the commercial characteristics of silkworm Bombyx mori L. as the cocoons obtained after rearing are of the utmost value as the entire income of farmers depends on it. Apart from the disease management, the botanical extracts have significant effect on silkworm growth and development. To investigate their impact on the commercial characteristics of silkworms, the extracts of three locally accessible botanicals, Datura stramonium (seed), Ficus carica (leaves), and Vitis vinifera (seed), were tested at three different concentrations, 10, 15, and 20%. The results showed that these botanicals, which were tested for their effectiveness on the commercial characteristics of silkworms, had no negative effects on the wellbeing of the silkworms or the calibre of the cocoons or silk. The silkworm characteristics, including its larval weight, larval duration, cocoon weight, shell weight %, and average filament length, were determined to be comparable to those of a healthy batch of silkworms (Untreated healthy). According to the study, these readily available local plants can be advised for use in preventing the dreadful muscardine disease in bivoltine silkworms (Bombyx mori. L.) in temperate climates. Farmers can also reap a good crop of cocoons with good returns because the botanicals have no negative effects on the characteristics of commercial cocoons.

Low-Cost Green synthesis of $BaFe_2O_4$ nano-structures for memory devices applications

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In this study, pure $BaFe_2O_4$ were prepared by low cost, eco-friendly and toxic free combustion method. Aloe-vera gel used as a fuel as well as stabilizing agent. The effect of calcination temperature on the size and morphology of $BaFe_2O_4$ has been investigated. The calcination temperature was obtained by using thermal gravimetric analysis. The high-resolution X-ray diffraction pattern indicating the formation of orthorhombic spinel like phase and Bb21m (36) space group of $BaFe_2O_4$

which is well matched with the standard JCPDS card no. 00-046-0113. It has been seen that the crystallite size increases with respect to the annealing temperature due to Oswald ripening. The surface morphology was obtained by field effect-scanning electron microscopy which shows the change of morphology with annealing temperature from nano-particles to hexagonal nano-flakes and nanorods. The energy dispersive X-ray spectrum shows that the material consists of Ba, Fe and O elements, no other impurities were present. Fourier transform infra-red spectroscopy spectrum having the metal-oxide peaks (Ba-O and Fe-O) in the fingerprint region which shows the successful formation of $BaFe_2O_4$ nano-structures. The diffuse reflectance spectroscopy was used to calculate the bandgap of the synthesized material by using Kubelka-Munk function. It was observed that the value of band gap energy decreases with increasing temperature. Vibrating sample magnetometer studies showed that the sample annealed at 1000°C having significant value of coercivity field. Thus, $BaFe_2O_4$ used for memory storage device applications.

Magnetic Energy dissipative factors of spin-coated $Y_3Fe_5O_{12}$ thin films

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$Y_3Fe_5O_{12}$ (YIG) is a ferrimagnetic insulator that shows significant potential in various applications such as spin pumping and optical devices. In the case of YIG, the uncompensated antiferromagnetic coupled Fe^{3+} ions originate the ferrimagnetic ordering (Sharma 2017). YIG is still a relevant material because of its lowest reported Gilbert damping constant which has significance in magnonics. A homogeneous YIG thin film with a lower Gilbert damping constant is essential for its industrial applications (Tserkovnyak 2002). Therefore, the YIG's intrinsic and extrinsic magnetic energy dissipative factors are crucial to explore. Here, the proposed poster will discuss the dissipative factors of polycrystalline YIG thin film grown on a thermally oxidized Si (100) substrate grown using sol-gel-based spin coating. X-ray diffraction and scanning electron microscopy will be used to confirm the phase and surface morphology. The elemental analysis of the deposited film will be presented using x-ray photoemission spectroscopy. The ferromagnetic resonance spectroscopy will be utilized to study the magnetic dynamics. Linewidth Vs frequency plot will be used to calculate Gilbert damping and inhomogeneous contribution to the linewidth. The poster will present the lowest Gilbert damping parameter of YIG deposited using sol-gel- based spin-coating. The cumulative results will be presented in the poster.

Keywords: YIG; Sol-gel-based spin-coating; Ferromagnetic resonance; Gilbert damping parameter.

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Augmentation of the antibacterial effect of planetary ball milled curcumin nanoparticles

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Keywords: Curcumin-nanoparticles, Planetary ball milling, Antibacterial activity.

Because of its antibacterial, antiviral, and antifungal capabilities, the polyphenolic molecule known as curcumin; has been discovered to have a wide variety of positive impacts on biological systems [1]. The curcumin that may be found in turmeric has been shown to be very useful in the treatment and prevention of a broad variety of disorders, including those that affect the neurological and immunological systems, the cardiovascular system, the metabolic system, inflammation, and even some malignancies [2, 3]. Curcumin, on the other hand, has a few limitations, including poor water solubility, poor absorption, and low bioavailability, poor stability, and inadequate targeting of penetration [4]. In order to improve curcumin water solubility and investigate its effects on its antibacterial capabilities, we have reported the production of spherical curcumin nanoparticles by using a planetary ball milling with a particular ratio of the ball which depends on time. This was done in order to improve curcumin ability to fight bacteria. Images obtained by scanning electron microscopy showed that the particle size distribution was around 45 nm. According to the analysis of their respective 1H NMR spectra, nanocurcumin and curcumin share the same exact chemical structure. For a variety of different bacterial and fungal species, the minimum inhibitory concentration of nanocurcumin was calculated and compared to the concentration of curcumin. It was discovered that a nanocurcumin solution that was disseminated in ethanol had a significant impact on pathogens such as Salmonella, Escherichia coli, K pneumonia, and Cholerae. After the particle size was lowered to the nano range, there was a discernible improvement in both the water solubility and antibacterial activity of curcumin.

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Study of Crystallite Size of $CuInS_2$ Nanospheres and Nanowhiskers Determined from X-ray Diffraction

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Keywords: $CuInS_2$, nanowhiskers, nanospheres, crystallite size, HRTEM.

$CuInS_2$ nanowhiskers (NW) and nanospheres (NS) are synthesized by hydrothermal and sonochemical techniques, respectively. The synthesized nanoparticles are characterized by X- ray diffraction (XRD) and energy dispersive spectroscopy (EDS). The XRD outcome revealed that the sample possesses crystalline tetragonal structure with lattice parameters a = b = 5.51 Å, c = 11.32 Å which agrees well

with JCPDS card no. 47-1372. The EDS result confirmed that the sample is near stoichiometry and free from any contaminants. The crystallite sizes of NW and NS are estimated via Scherrer's method (graphical and analytical), Williamson-Hall relations (uniform deformation model, uniform stress deformation model, and uniform deformation energy-density model), Halder-Wagner relation, and size-strain plot methods compared with HRTEM analysis. Physical parameters such as lattice stress, strain, and energy density are also evaluated more precisely from the XRD pattern reflection peaks. The outcomes showed excellent intercorrelation of the average crystallite sizes as estimated by employing various methods.

Investigation of photocatalytic activity of homologous compounds (ZnO) k In 2 O 3 (k=3, 5 & 7) in visible light towards dye degradation

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Keywords: photocatalysis, dye degradation, methylene blue, metal oxides, waste treatment.

Over the last decade, there has been significant progress in the field of ZnO-based photocatalysts. However, pristine ZnO has a high recombination rate of photo-induced holes and electrons, which limits its use in visible light photocatalysis. To overcome this issue, homologous compounds (ZnO) kIn_2O_3 nanoparticles were synthesized using low cost citrate gel method (k=3, 5, & 7). The effect of variation in k values associated with ZnO in the ZnO- In_2O_3 system is realized by analysing its structural, optical, and morphological studies investigated with the help of X-ray diffraction, UV-Visible Spectroscopy, Photoluminescence Spectroscopy, and Transmission Electron Microscopy. X-ray diffraction analysis confirmed rhombohedral structure and the crystallite size was between ~30 to ~35 nm. The bandgap calculated using tau'c plot was found to be between 2.70 eV to 3.06 eV. Photoluminescence spectroscopy revealed the emission spectrum of the synthesized composites. Transmission Electron Microscopy revealed the morphology to be quasi spherical along with some elliptical geometries, and average particle size was ~53 nm. The photocatalytic performance of the pristine and composite samples was evaluated using methylene blue (MB) as a probe pollutant under visible light irradiation (λ=375nm). The photodegradation ability was significantly improved after introducing In_2O_3 as a support to form type II heterojunction. The formation of type II heterojunction reduces recombination rate and ultimately boosts the photon absorption ability. Effects of various parameters such as initial dye concentration, catalyst loading, and pH were studied. When the reaction took place in the presence of scavengers, hydroxyl radicals (OH) were identified as the reactive species responsible for photodegradation. The effect of catalyst loading, initial dye concentration, and pH variation were evaluated. The nanoparticles were found to be effective for the degradation of MB in visible irradiation, degrading 95% dye within 3 hours. Increase in dye concentration decreased the degradation rate, which is due to the increased number of dye molecules that are adsorbed on the photocatalyst surface [1] . Rate of photodegradation of cationic dye MB was increased in basic pH since point of zero charge of synthesized catalyst was around pH 8.

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First Principles Study on Electronic and Structural Properties of TiS_3 Under High Pressure

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Keywords: TiS_3, high-pressure, phase transition, first principle study.

Due to numerous industrial applications, titanium trisulfide (TiS_3) has been the focus of extensive research like photo-voltaic and thermoelectric devices. Pressure may offer a way to enhance the physical or chemical properties of materials because of its well-known effects on inter atomic distances and crystal structures. Here from the first principle calculations, pressure induced metallization of TiS_3 is identified near 18 GPa and high pressure equation of states are calculated. Two structural transitions are predicted. The first transition near 18 GPa is iso- structural with a volume jump nearly 3% and the second transition near 60 GPa is from the monoclinic phase to a cubic phase with a large volume jump (~10%). The equilibrium lattice constants and the bulk modulus is calculated by fitting the total energy as a function of the cell volume to the 4th order Birch-Murnaghan (BM) equation of state. In the first transition the ambient layered packing pattern remains unaltered but the second transition associated with the destruction of layered packing pattern with S-S units. Band gaps are calculated accurately at ambient pressure using hybrid functional and found to be nearly around 0.964 eV compared to the experimental value 1.0±0.1 eV. Positive phonon frequency from Phonon calculation confirms the stability of the structure under small atomic displacement. All 13 independent elastic constants, C_{ij} of monoclinic structure are found to be positive and found to be obey Born stability criteria.

Fabrication and characterization of graphene oxide and reduced graphene oxide

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Graphene has gained tremendous attention in the field of photonics and electronics because of its numerous outstanding properties like zero bandgap, exceptionally high crystal and electronic quality, high mechanical strength, electrical conductivity, molecular barrier abilities and other remarkable properties. In this work, Modified Hummer's method is used for the fabrication of graphene oxide

(GO) and reduced graphene oxide (rGO). rGO is obtained with the help of thermal reduction of GO at 350°C for 1 hour. The intensity of XRD peak, corresponding to (001) and (002) plane for GO and rGO respectively, confirms the crystalline nature. The Raman peaks of GO and rGO powder observed at 1358 cm^{-1} and 1597 cm^{-1} corresponds to the D bands and G bands, respectively. Scanning electron microscope (SEM) images showed layered structure of rGO.

Keywords: Graphene; GO; rGO, Hummer's method.

DEVELOPMENT OF NOVEL LIPID-BASED WATER DISPERSIBLE NANO DRUG DELIVERY SYSTEM FOR THE EFFECTIVE ORAL DELIVERY OF HYDROPHOBIC DRUGS

Aim: To develop and characterize Methotrexate (MTX) loaded lipospheres for effective oral delivery to revamp its therapeutic profile.

Objectives and methodology: The approach in this experiment was to develop lipospheres of MTX by thin film hydration method and characterize it for micromeritics, surface charge, surface morphology and drug entrapment and drug loading. The formulation was further evaluated for drug release kinetics, in-vitro cytotoxicity assay and pharmacokinetics. All the results were compared with the plain MTX suspension.

Results & discussion: The average size of the lipospheres was 166.7 nm and drug entrapment efficiency was found to be 87.1%. In the gastric pH, the release of MTX was around 5.2 %, whereas, in the intestinal pH, the release from the MTX-loaded lipospheres was in a controlled manner. Surprisingly, in the plain MTX, around 60% of the contents were released in the gastric pH and the whole content was released in the intestinal pH in an accumulative period of 3 h. Better release at pH 6.8 from the lipospheres, advocates better absorption from the intestine. The formulation was cleared at a rate less than half of that of MTX suspension from the body of rats. The cytotoxicity of the developed system was more pronounced than the plain MTX on MCF-7 cancer cells, advocating better efficacy.

Conclusions: The problem of less bioavailable MTX by oral route was successfully revamped by the lipospheres composed of biocompatible lipids. Hence, it can be concluded that water-dispersible lipospheres have the potential for the effective and safer oral delivery of hydrophobic drugs.

Keywords: Lipospheres, Methotrexate, Release kinetics, Pharmacokinetics.

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Growth kinetics and morphology characterization of binary polymeric fluid under random photo illumination.

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The phase separation kinetics of binary polymeric fluids (polymer blend having active radical at one end of the chains, and block copolymer (BCP) melt with photo-sensitive bond connecting both the incompatible blocks) are studied using the dissipative particle dynamics (DPD) simulation method in . The uniformly mixed system prepared at high temperatures, undergoes phase separation when quenched below the critical temperature. Simultaneously, we let the system pass through random photo illumination. During the on-cycles, the photo-sensitive bonds in the BCP chains break. Whereas off-cycles recombine the active radicals at the end of incompatible polymer chains to form photo-sensitive bonds. We focus on studying the domain evolution, scaling functions, length scale, and other connecting parameters to understand the effect of random photo illumination on these systems. The variation of bond-breaking probability mimics the effect of change in light intensity. It is observed that the length scale of evolution changes drastically with light intensity variation for the given bond recombination probability (). However, the length scale curves follow power law growth, where is the growth exponent in different growth regimes. With the increase of, a gradual transition from microphase to macro-phase separation is noted

Keywords: DPD Simulation; Phase separation; BCP melt; Polymer Blend; Bond-breaking reactions

INSULATOR-METAL-TRANSITION AND NEAR-FIELD NANO-IMAGING IN VO_2 THIN FILM

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In correlated insulators, Coulomb repulsion between electrons inhibits their ability to conduct electricity. However, if the insulator is doped or heated, an insulator-to-metal transition (IMT) can occur, resulting in a conducting state that differs significantly from that of conventional metals, which contain free electrons. Our investigation analyzes the electronic characteristics of vanadium dioxide (VO_2), which is an exemplary correlated insulator where the metallic state can be triggered by a rise in temperature (Ojha et al., 2022). Using scattering type scanning near-field optical microscopy (s-SNOM), we are able to directly visualize nanoscale metallic domain that emerge at the onset of the IMT (Qazilbash et al., 2007). When combined with far-field infrared spectroscopy, our data indicates that the Mott transition takes place in these metallic domain, with a divergent quasi-particle mass. The experimental technique utilized presents new avenues for investigating charge dynamics at the nanoscale in other correlated electronsystems that display inhomogeneity and to observe the

percolation effect in form of nanoscale metallic nano-domain and reveal the strongly correlated conducting state. Temperature dependent impedance spectroscopy measurements indicate the distinct resistive and capacitive contribution to the dielectric response of VO_2 thin film as a function of frequency across the IMT.

KEYWORDS: Mott Materials; Insulator-metal-transition; VO_2; Thin Film.

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Transient WORM Memory Device using an enzyme for sustainable electronic applications

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Keywords:WORM memory; Enzymatic protein; Transient electronics; High stability; Non-cytotoxic

Electronic devices with biocompatibility and transient nature are of great importance due to its high potential towards the sustainable solution of hazardous e-wastes. The explosive growth in digital data results in the urgent demand of high density data storage device. In this regard, resistive switching (RS) based memory devices could be an alternative to the present Si-based memory devices. In this research work, we employed a biocompatible enzyme Lysozyme (Lyso) as the active layer to design resistive switching memory device having device structure Au/Lyso/ITO. Interestingly the device showed transient, WORM memory behavior. It has been observed that the WORM memory performance of the device was very good with high memory window (2.78×10^2), data retention (upto 300 minutes), device yield (~ 73.8 %), read endurance (33 cycles), high physical stability (experimentally >700 days, extrapolated to 3000 days). Bias induced charge trapping followed by conducting filament formation was the key behind such switching behaviour. Transient behavior analysis showed that electronic as well as optical behaviour were completely disappeared after 10 seconds dissolution of the device in Luke warm water. Cyto-toxicity of the as prepared device was tested by challenging two environmentally derived bacteria and found to have no biocidal effects. Hence the device would cause no harm to the microbial flora when it will be discarded. As a whole this work suggests that Lyso based WORM memory device could play a key role for the development of designing transient WORM memory device for sustainable electronic applications.

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Nanoarchitecture for Building Sustainability

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Nanotechnology is considered as an emerging technology which has caught attention of both developing as well as developed countries. Presently, construction industries are looking for more Sustainable Materials which are cost effective and eco-friendly. Nanomaterials with new properties like increased density, reduced porosity, increased strength, self-healing of cracks, reduction in shrinkage, decrease in corrosion, thermal insulation, etc. can be produced. Nanotechnology has evolved from way of ravishing, thinking and shaping in architecture facades into new architecture designs which are more sustainable. We can opt for Nano concrete cladding by mixing TiO_2 or SiO_2 to traditional concrete mix for more tensile strength, self-cleaning etc. Nano treated wood can increase hardness of wood; protect it from UV radiations etc. Nano treated glass and paints for self- cleaning and Anti-Bacterial effect respectively. So, these Nanotechnology approaches can lead to a sustainable way of saving energy and avoiding Hazards. Therefore, achieving economic development and sustainable future.

KEYWORDS: Nanoarchitecture, Sustainable Materials, Anti-Bacterial effect, architecture facades.

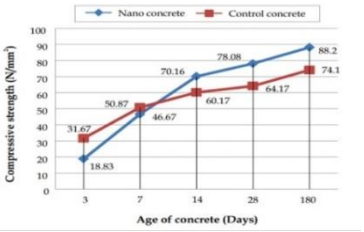

Figure 1: Compressive strength

Figure 2: NANOWOODS (as resistance of water)

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NANOSILICA FOR THE STABILIZATION OF WEAK ROADS INORDER TO GET NANO SMART ROADS

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Nanotechnology is tremendously extending research in Road Engineering by Manipulating the mechanical properties like durability, hydrophobicity, depth of penetration, specific depth, anti-ageing

properties, increase in fatigue and many other properties. Traditionally used actions for protection are notoriously expensive and sometimes difficult to use below certain temperature. Various quality tests have been carried out to characterize the effect of nano-silica induced bitumen and normal bitumen. Through CBR Test (California Bearing Ratio) we came to know on adding 1.5% and 3% of nano silica with Bitumen is more effective than other approaches. The additive Nano Silica will not only increase the mechanical properties but will also help us to get hydrophobic Roads that will be long lasting. The hydrophobic road will be the biggest achievement especially in Jammu and Kashmir as here the snow wipe-out the roads rapidly.

KEYWORDS: Nanotechnology, Nano Silica, Hydrophobicity, Bitumen.

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Cost-effective production of H_2 and sulfur by electrochemical decomposition of H_2S

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Keywords: Electrooxidation, Hydrogen sulfide, Hydrogen, Sulfur passivation.

The electro catalytic decomposition of H_2S is a promising technology for H_2 production as well as targetting environmental pollution. But due to the lack of low-cost and efficient electrocatalysts, this technology for H_2 production is not being explored much. Moreover, the highly toxic and copious waste H_2S released from industries is rarely encountered in the scientific domain. Herein, we have designed a highly efficient electro catalyst i.e., CoCd(x:y)Sn as an anode catalyst for sulfide oxidation reaction (SOR). This optimized catalyst could drive the anode reaction at an onset potential of 0.25 V vs. RHE which was 1.30 V lower than that required for the water oxidation reaction as shown in Fig. 1. Thus, H 2 S electrolysis is an energy-saving approach. Moreover, we have achieved 98% H_2 faradaic efficiency with remarkable stability of 120 h. Thus, this method paves a path to high-value utilization of hazardous waste H_2S and demonstrates its great potential for hydrogen production and sulfur towards sustainable energy applications.

Aiming the CO_2 Reduction and Energy Storage via a Rechargeable Zn-CO_2 Battery

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Keywords: Zn-CO 2 battery, carbon dioxide reduction, bifunctional catalyst, boron and nitrogen containing carbon, energy storage and conversion.

Being an important part of the carbon cycle, carbon dioxide (CO_2) is essential for sustaining life on Earth. However, in the practice of fulfilling the energy demands, CO_2 amount in the atmosphere has increased to a level which is life threatening. Therefore, CO_2 reduction to value-added alcohols having industrial significance using renewable energy sources is necessary. In that regard, the electrochemical energy storage devices are considered to be a promising alternative to fossil fuels. Combining the electrochemical CO_2 reduction (e-CO_2R) with Metal-air batteries 2 is an effective way to target CO_2 utilization and energy storage and conversion through an aqueous rechargeable Zn-CO_2 battery. The rechargeability depends on the ability of the electrocatalyst to show bifunctional activity for CO_2R and oxygen evolution reaction (OER) or the oxidation of the CO_2 reduction products. Till date, a diverse range of transition metal-based catalysts have been explored for the e-CO_2RR. However, selectivity in reduction to liquid fuels like alcohols. In this aspect, formation of metal-organic frameworks (MOFs) composites with carbon or formation of carbonaceous materials by post-synthetic treatment of MOFs can effectively enhance the stability and conductivity of MOFs and can prove to be a viable approach for use as bifunctional electrocatalysts in Zn-CO_2 batteries.

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Optical Properties of Chemical Bath Deposited $NbSe_2$ Thin Film

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In the present era of technology, transition metal dichalcogenides (TMDCs) are an emerging class of nanomaterials that had attracted attention in the field of optoelectronics, organic/ inorganic photovoltaic devices, biosensors, etc. Among the TMDCs, the niobium dichalcogenide ($NbSe_2$) belonging to group V-VI is expected to be promising material in the field of optoelectronics such as

light emitters, detectors, and solar cells. In the present study, $NbSe_2$ thin films deposited via chemical bath deposition technique at the ambient temperature (303 K) are reported for the first time. The compositional element analysis and structural analysis of deposited thin films are characterized by Energy Dispersive Analysis by X-rays (EDAX) and X-Ray Diffraction analysis (XRD), respectively. From the EDAX analysis, it is obtained that the deposited thin film is pure $NbSe_2$ and no other impurity is present, whereas the XRD data revealed that the deposited thin films have hexagonal structure and belong to space group P6 3/mmc with the lattice parameters of a = b = 3.446 Å, c = 12.581 Å, and $\alpha = \beta = 90\ 0$, $\gamma = 120\ 0$ which agrees well with JCPDS card no. 018-0923. UV-Visible spectroscopy is employed to study the optical properties of the deposited thin film. Different parameters of optical properties such as the energy of direct and indirect bandgap, optical density, skin depth, Urbach parameter, stiffness parameter, and real and imaginary parts of dielectric constant are estimated and discussed in detail.

Keywords: Thin film, nanotechnology, TMDC, chemical bath deposition, optical properties.

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Strategy to Improve the Photovoltaic Performance of Si/CuO Heterojunction via Incorporation of Ta_2O_5 Hopping Layer and MXene as Transparent Electrode

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Keywords: pyramidal silicon, p-CuO, Ta_2O_5, MXene, heterojunction solar cell, surface Passivation.

Recently, metal oxide semiconductors, especially copper oxides, have engrossed researchers in the domain of solar cells due to their good optoelectronic properties. The present study reports the development of a heterojunction of CuO and Ta_2O_5 on pyramidal Si decorated with a thin MXene coating as a transparent conductive electrode. Further, the impact of annealing ambient on the crystalline quality and phase selectivity of the as-deposited Cu_xO_y film has also been investigated. The as-designed Si/Ta_2O_5/CuO/MXene heterostructure shows improved efficiency as compared to the

counter device without a Ta_2O_5 passivation layer by 109 factors. The superiority of the as-designed heterojunction has been examined in terms of short-circuit current density of −10.5 mA/cm^2 and photoconversion efficiency of ∼1.47%, respectively. Therefore, the work emphasizes the importance of the combination of n-Ta_2O_5 and p-CuO film as the wide- and low-band-gap materials for the future low-cost solar cell compatible with the Si process line technology.

Metal-free triazine and porphyrin-based polymeric network for the natural sunlight-driven simultaneous CO_2 reduction and benzylamine oxidation

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Keywords: CO_2 photoreduction, metal-free organic polymer, benzylamine oxidation.

Solar-driven photocatalytic CO_2 conversion to value-added chemicals and fuels is one of the most promising and sustainable processes to curtail the issues related to climate change and energy crisis. However, achieving high efficiency for CO_2 photoreduction remains a challenge, especially without the assistance of any metals or sacrificial agents, which restricts the practical applicability of the photocatalytic process. In this contribution, we have synthesized a metal-free triazine and porphyrin-based porous organic polymer (TPT-prop) for photocatalytic CO_2 reduction under natural sunlight. CO_2 was reduced to CO as a fuel, with an exciting rate of 1423 mmolg^{-1}h^{-1} by the photogenerated electrons. Instead of using any sacrificial agent to scavenge the photogenerated holes, benzylamine was used, which on hole-assisted oxidation yielded corresponding imine i.e. N-benzylbenzaldimine. The conversion of benzylamine to imine was found to be 65% in 6 hours with a high selectivity of 98%. EPR studies and CO_2 labelling experiments were carried out to establish the mechanism for the CO_2 reduction process. Thus we showed the effective utilization of electron-hole pair synergistically to boost the overall atom economy. These results provide a sustainable strategy for cost-effective CO_2 photoreduction and open up a new horizon for solar-to-fuel and fine chemical conversion.

Aqueous zinc sulfur battery as next-generation energy storage device

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Keywords: ZnS battery, conversion mechanism, zinc corrosion, aqueous battery and additive.

Globalization and incessantly increasing population have led to a rapid upsurge in the world's energy demand. But their efficacious usage is unviable without energy storage devices. Li-ion batteries are market leaders but bottlenecked by challenges of dearth Li resources, fully inert and high-cost production, utilization of flammable organic solvents, limited capacity and energy density etc. [1] So,

high capacity (1675 mA h g^{-1}) sulfur-based cathodes are proved to be instrumental as they are rendered by conversion mechanism, low cost, environment-friendly and non-toxic nature along with earth abundancy. [2] Alkali and alkaline earth metal sulfur batteries are explored, amongst which LiS batteries are widely examined for energy storage applications that utilize organic electrolytes and sulfur-based cathodes. However, polysulfide shuttling and flammability risk are severe problems in these systems. So, along with sulfur utilization of aqueous compatible cathode is required. [1, 3] In this regard, usage of less reactive zinc anode comes with additional benefits of having high abundance, high energy density, high specific capacity (810 mAh g^{-1}), low cost, less toxicity, recyclable, moderate electrochemical potential window (−0.76 V vs SHE), flammable safe and high safety etc but suffered from corrosion because of which dendrites are formed. Addition of additives to the electrolytes plays a very crucial role of providing a high stability of anode along with reducing water activity. [4] We have examined additive for ZnS battery performance battery system which provides an outstanding capacity of 1200 mA h g^{-1} at 0.1^{o}C with a remarkable reversible cycling stability over 300 cycles @ 1^{o}C.

Experimental and computational insights into luminescence in atomically precise bimetallic $Au_{6-n}Cu_n(MPA)_5$ (n=0-2) clusters

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Keywords: nanoclusters, doping, HOMO-LUMO gap, DFT, phosphorescence.

Doping is an efficient alternative strategy for modification of the optical, and electronic properties, and catalytic activities by structural alterations. We used a one-pot synthesis to produce a highly luminescent monometallic and bimetallic nanocluster (NCs). MALDI-TOF mass spectrometric analysis reveals the composition of Au NCs is $Au_6(MPA)_5$, and the bimetallic nanocluster is $Au_4Cu_2(MPA)_5$, where 3-mercaptopropionic acid (MPA) is used as capping ligand. We can tune the photoemission band from 520 nm to 620 nm after copper incorporation into Au NCs. The PL QY enhances from 6% to 13% after incorporating the Cu dopant atom. Further, we investigated optimized structures of as-synthesized NCs by using density functional theory (DFT) and reports the HOMO-LUMO gap which is consistent with the experimentally observed red shift in UV-Vis absorption features of Au NCs upon copper doping. The XPS studies suggest the formation of intermixing of states between 5d of Au and 3d of Cu in AuCu NCs after incorporating Cu atoms in Au NCs, which is corroborated by the DFT calculations on electronic charge transfer from the Cu to Au atom in the NCs. The coupling between Au(I) and Cu(I) facilitates the formation of a low-lying mixed Au(I)-Cu(I) energy state. We hope this synthesis method provides a novel strategy for developing bright luminescent Au and AuCu NCs in an aqueous medium.

Cationic Polymer Functionalized Copper Nanocluster Based Fluorescent Probe for the Selective and Sensitive Detection of S_2-Ions

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Keywords: copper nanoclusters, fluorescent probe, electrostatic interactions, AIE, quenching.

The sensitive and selective detection of sulfide (S^{2-}) ions in water is of major interest due to its toxicity and physiological effects on organisms. We have designed a fluorescent probe, poly (allylamine) hydrochloride (PAH) functionalized copper nanoclusters (Cu NCs@PAH) for the detection of S^{2-} ions. The synthesis of the probe is based on the electrostatic interaction between negatively charged Cu NCs and positively charged polymer, PAH. The drastic enhancement of the photoluminescence (PL) intensity of Cu NCs and the quantum yield (QY) enhancement from 0.3% to 6% is evident after functionalizing with a cationic polymer matrix of PAH. The steady-state and time-resolved fluorescence studies support the aggregation-induced emission (AIE) phenomenon for PL QY enhancement. In addition, the Cu NCs@PAH exhibits excellent selectivity towards aqueous S^{2-} ions. The probe displays a reasonable quenching response for S^{2-} ions over a concentration range of 0-20 µM with a detection limit of 2.39 µM. We believe that this facile and economical synthesis methodology of Cu NCs@PAH with interesting AIE properties will extend the scope of previously available techniques for the detection of S^{2-} ion.

FOLIC ACID-FUNCTIONALIZED BOVINE MILK EXOSOMES LOADED WITH PACLITAXEL AND 5-FLUOROURACIL FOR IMPROVED THERAPEUTIC EFFICACY AGAINST BREAST CANCER

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FDA have approved Paclitaxel (PAC) against breast cancer for the clinical use (Taxol®) (Buzdar et al., 2007) , but it still exhibits dose-dependent side effects due to the existence of Cremophor EL® (adjuvant) with ethanol (Alves et al., 2018, Fader and Rose, 2009) . Such drawbacks can be overcome by current approaches which include (i) finding an appropriate carrier bypassing the above adjuvant, and also suitable for oral delivery, and (ii) combination of PAC with other anticancer drugs, thereby providing a synergistically improved anticancer activity (Mokhtari et al., 2017, Kandimalla et al., 2021) . Under such circumstances, we prepared Folic acid (FA) functionalized exosomes, derived

from bovine milk for the oral delivery of PAC and 5- fluorouracil (5-FU). Exosomes showed 80-100 nm particle size, ~0.20 polydispersity index (PDI), ~ −25 mV zeta potential, ~82% entrapment efficiency, ~28% drug loading, and significant sustained drug release profile for 48h. Additionally, the drugs loaded exosomes significantly decreased the IC50, which further got improved when functionalized with FA. Further, FA-functionalized coumarin-6-loaded exosomes exhibited increased cellular internalization, as compared to free coumarin-6. Additionally, FA-functionalized drug-loaded exosomes demonstrated an enhanced apoptotic index with improved management over cell migration. It was thus concluded that folic acid functionalized exosomes loaded with combination drugs provided an enhanced anticancer efficacy against breast cancer (Kumar et al., 2022).

Keywords: Exosomes; Breast cancer; Paclitaxel; 5-fluorouracil; Chemotherapy.

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A novel Zn-Doped CQD for efficient and combined photo catalytic degradation of water pollutants-MeEthylene Blue and Moxifloxacin Under UV-light irradiation

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Keywords- Zn-CQD, Microwave irradiation method, Photo catalytic degradation. Methylene blue, Moxifloxacin. Water remediation.

A novel photo catalytic material Zinc-doped carbon quantum dots (Zn-Cqd) is synthesized using microwave irradiation method for combined and efficient photo degradation of two different water pollutants. First category being dyes which are released in to water bodies from textile industries, which reduces light penetration in water bodies, consequently reducing dissolved oxygen which is

extremely essential for both under water flora and fauna.[1] The other pollutant is antibiotics which are released into water bodies by pharmaceutical companies and hospitals.[2] The presence of antibiotics in water bodies is dangerous for both animals and humans consuming water as it increases the antibiotic resistance in animals and humans leaving them at higher risk of bacterial infection.[3] The synthesized Zn-CQD shows excellent degradation efficiency for of methylene blue and moxifloxacin. Morphology of synthesized material is determined using transmission electron microscopy. The average size is found to be 3 nm. The morphology of synthesized Zn-CQD is spherical.. UV-vis spectroscopy is used to determine the band gap of Zn-CQD which is 2.6 eV . FTIR spectroscopy and fluorescence spectroscopy of synthesized material is also carried out. The excitation wavelength is 360 nm and emission wavelength found to be 454 nm. Degradation of textile industry water pollutant methylene blue and antibiotic moxifloxacin is also reported with degradation efficiency of more than 90%. Simultaneous degradation of both pollutants is also carried out and its degradation efficiency is also found to be more than 90%.

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Microstructure and Ferroelectric properties of barium titanate based ceramics

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Keywords – Ceramics, Ferroelectric, Surface morphology, Liquid Phase.

Barium titanate ($BaTiO_3$), barium zirconate titanate $Ba(Zr_{0.10}Ti_{0.90})O_3$, barium calcium titanate $(Ba_{0.85}Ca_{0.15})TiO_3$, and barium calcium zirconate titanate $(Ba_{0.85}Ca_{0.15})(Zr_{0.1}Ti_{0.9})O_3$ ceramics have been synthesized using a conventional solid-state reaction route. The homogenized ingredients of all compositions were calcined at 1250^{o}C for four hours and sintered at 1500^{o}C for 6 hours. The surface morphology of sintered ceramics has been investigated for all four compositions using a scanning electron microscope. The average grain size of the sintered barium titanate ceramics is found to be ~ 145 nm, indicating that the material has reached to the liquid phase at the sintering temperature. The grain size of barium zirconate titanate (BZT), barium calcium titanate (BCT), and barium calcium zirconate titanate (BCZT) ~ 4.41, 20.29 and 6.02 nm respectively. The Microstructure of Ca-doped barium titanate ceramics shows a diphasic region with two distinct grain size distributions.

Temperature-dependent P-E hysteresis loop measurements have been done on BCT and BCZT ceramics from room temperature to 130^{o}C. Room temperature values of coercive field Ec and remnant polarization Pr for BCT ceramics are ~ 0.73 kV/cm and 4.2 nC/cm 2 , and for BCZT ceramics the Ec and Pr values are ~ 0.82 kV/cm and 1.11 nC/cm 2 respectively.

First-Principle Investigation with the Thermoelectric study for a hexagonal monolayer of group III-VA Metal-Phosphides

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Since thermoelectric generators can convert heat directly into electricity, they have been the focus of extensive research. The thermoelectric properties of conventional inorganic and organic materials have significantly improved over the past few decades. Layered two- dimensional (2D) materials are a class of materials that have attracted much scientific interest as promising thermoelectric materials. Graphene, black phosphorus, transition metal dichalcogenides, III-IV compounds, and Mxenes are a few examples of these substances. Here, using density functional theory and Boltzmann transport theory, a first-principles investigation of the thermoelectric (TE) properties of a number of single-layer 2D materials has been carried out. We have investigated the hexagonal monolayer of the group IIIA-VA family X-Phosphides, where X = B, Al, Ga, and In. We discovered that all the compounds were stable in their hexagonal monolayers based on their structural and vibrational properties. In low-level calculations, the hexagonal monolayer of AlP was not determined to be stable, but in our case, at this level of calculation, we obtained this material as stable. We also studied the materials electronic properties, computing the projected density of states and band structure for each material. For calculations including electronic and vibrational properties, the density functional theory (DFT) technique has been considered. The Seebeck coefficient, electrical conductivity, thermal conductivity, and Figure of Merit (ZT) were all evaluated using the semi-classical Boltzmann transport equation (BTE), which allowed us to obtain the temperature-dependent transport parameters for all materials taken into consideration. The findings provide excellent evidence of this material potential as a thermoelectric material.

Keywords: DFT, Thermal conductivity, Seeback Coefficient, Figure of Merit

Effect of sintering temperature and time on the microstructure and ferroelectric properties of BCZT ceramics

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Ca-doped barium zirconate titanate $(Ba_{0.85}Ca_{0.15})(Zr_{0.10}Ti_{0.90})O_3$ (BCZT) ceramic composition has been synthesized using the solid-state reaction method. The ingredients of BCZT composition were ball milled and calcined at 1200, 1300 and 1400^{o}C for 4hrs. BCZT compositions calcined at 1200 and 1400^{o}C for 4hrs were sintered at 1500^{o}C for 6hrs, whereas the material calcined at 1300^{o}C was sintered at 1500^{o}C for 8hrs. XRD and Raman measurements on the calcined powder reveal the phase pure synthesis of the BCZT composition with coexistence of rhombohedral, orthorhombic, and tetragonal phases. The microstructure of BCZT ceramics was examined on the unpolished surface of as-sintered ceramic using a scanning electron microscope (SEM). The average grain size of material which was calcined at 1200 and 1400^{o}C for 4hrs and sintered at 1500^{o}C for 6hrs are ~ 6.9nm, 9.5nm and the material calcined at 1300^{o}C and sintered at 1500^{o}C for 8hrs ~18.3nm. P-E hysteresis loop measurement has been carried out on BCZT ceramic sintered at 1500^{o}C for 6 and 8 hrs. Room temperature coercive field E C, and remnant polarization Pr for BCZT ceramic sintered at 1500^{o}C/6hrs are ~ 2.8 kV/cm and ~3.08 nC/cm 2 respectively, and for the material sintered at 1500^{o}C/8hrs these are ~ 2.98 kV/cm and 7.28 nC/cm^2. It is observed that the average grain size and remnant polarization of the BCZT ceramics improve with increasing the sintering temperature and soaking time.

Keywords: Ferroelectrics, Ceramics; X-Ray Diffraction; Raman Spectra.

Application and Implication of Nanotechnology in Designing Drug Delivery Strategies for Cerebral Ischemia Therapeutics

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Cerebral stroke is one of the leading causes of disability and death worldwide, which requires a specific and efficient neuroprotective approach to combat the deleterious pathophysiological outcomes. Intravenous administration of tissue plasminogen activator (tPA) is a single FDA-approved drug available for treatment with the limitation of short administration window [1]. Beside the rTPA treatment, the other paradigm of ischemia treatment is to protect the brain tissue damage from the ischemic insult. In this connection, several small molecules have been studied over the past decade to explore their neuroprotective potential. While the lab-based results indicated towards several potent candidates that can be further developed into neuroprotective drugs, but none of them has emerged as successful in clinical trials. One of the major reasons behind these failures is the inability of most of neuroprotectants to cross the blood brain barrier (BBB) due to their size and large molecular weight [2]. In such scenario, nanotechnology-engineered drug delivery holds a promising strategy to replenish the blood flow and lost brain functions [3]. Nanoparticles loaded with therapeutic agent can be customized to avoid opsonisation and allow controlled specific targeted drug release. It enables efficient drug encapsulation and better biocompatibility via surface modification [4]. In this review, we corroborated the current status, therapeutic potential and pharmokinetic aspects of neurotherapeutic nanoformulations to facilitate the enhanced drug delivery to cross over the BBB for ischemic stroke.

Keywords: Neurotherapeutics, Neuroprotection, Nano-formulations, Blood-Brain-Barrier (BBB), Targeted Drug delivery.

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Observation of N-Type to P-Type Transition in Thermoelectric Response of Palladium Diselenide

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From last decades, 2D material gained scientific interest especially with the discovery of graphene by Novoselov. Due to unique and unusual properties promising applications in various areas like Photovoltaics, Thermoelectrics, optoelectronics, sensing applications and more. Among the family ofsemiconducting Transition metal dichalcogenides, $PdSe_2$ a member of group 10 TMDs (Nobel TMDs) which has pentagonal structure (low symmetry lattice structure), low phonon group velocity and band valley convergence which make it efficient thermoelectric material. So, in this work, standard techniques have been followed for device fabrication, electrical and thermoelectric measurements and the thickness dependent thermoelectric behaviour of the $PdSe_2$ is presented. The behaviour is hypothesised to be caused by a shift in the fermi level of PdSe2 as thickness increases and the VBM approaches the work function of gold. it is explained through the theoretical calculations where electronic band structure and density of states (DOS) are calculated using First-principles calculations (VASP). In order to get accurate band gap Heyd-Scuseria-Ernzerhof (HSE06) hybrid functional is used. The Brillouin zone integrations were performed using the Γ centered 15 × 15 × 1 k-meshesfor both the PBE as well as Heyd-Scuseria-Ernzerhof (HSE06) calculations. This research investiagte the $PdSe_2$'s potential in thermoelectric devices and aids in understanding the transport behaviour of $PdSe_2$ with thickness.

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EFFECT OF POLYMER CHAIN PACKING ON MOLECULAR CHARGE TRANSPORT IN ORGANIC ELECTRONIC DEVICES

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Traditional electronic tech faces limits, exposed as Moore's Law wanes. Shrinking discrete devices, like transistors, drives performance but manufacturing and leakage issues arise at atomic sizes. Heat generated by small, dense devices is also challenging (Radamson et al., n.d.; Zhao et al., 2022). These limitations have driven researchers to explore new technologies. The potential of semiconducting polymers/foldamers in electronic applications, such as organic thin film transistors (OTFTs), solar cells, and flexible electronics, has garnered considerable attention. These materials are appealing due to their low-cost processing, flexibility, and unique optoelectronic properties, biodegradability, and environmental friendliness (Jiadi Chen, Weifeng Zhang, Liping Wang, 2022). The charge transfer properties of organic polymers are heavily influenced by their molecular structure, which has a significant impact on the efficiency of devices such as organic field effect transistors, organic solar cells, and organic light emitting diodes. Therefore, it is crucial to explore the molecular architecture of these materials to boost device efficiency. This study aimed to comprehend electron transfer in the π-π stacking interactions of synthesized P1-PEG polymer and its guest-host interactions, as well as to fabricate a P1-PEG polymer solution-processed OTFT with a carrier mobility of 0.027 cm 2 V -1 s^{-1} , operating at 30 V with negligible hysteresis.

KEYWORDS: organic electronics; conducting polymers; nanofabrication; bio-degradable;

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Fe_3O_4 decorated paper electrode as binder-free trifunctional electrode for electrochemical ammonia synthesis and Zn-O_2 batteries

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Keywords: Paper electrode, electrochemical nitrogen reduction, ammonia, ORR, OER, Zn-O_2 battery.

Conversion of the abundant biodegradable material into electro-active electrode material can be a good asset for sustainable energy conversion and storage. Cellulose is the most abundant biopolymer with high mechanical flexibility due to which it has emerged as an ideal substrate for electrode fabrication. But its insulating nature is the biggest hurdle for electrode fabrication. Herein, we present a cost-effective and green approach for the fabrication of flexible cellulose paper electrode via electroless-electrodeposition method. One-step electroless deposition route is followed to induce conductivity into non-conductive cellulose paper then Fe_3O_4 is electro-deposited over it for electrochemical activity. The as-fabricated paper electrode illustrates promising activity and stability during the dinitrogen reduction reaction (NRR) as well as oxygen bifunctional electrocatalysis. A Faradaic efficiency of 4.32% with yield rate 245 µg h^{-1} mg_{cat}^{-1} at -0.1 V during NRR is achieved whereas a low overpotential of 180 mV is required to reach 10 mA cm^{-2} during OER and the ORR reaction starts at the onset potential of 0.86 V. The Zn-O_2 battery assembly shows a peak power density of 81 mW cm^{-2} and stability upto 35 h during charge-discharge cycles, which can power NRR to produce NH_3 under full cell conditions.

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Detection of Mercury in Seawater using Carbon Dot-Carboxymethyl Chitosan Sensor with Electrochemical Impedance Spectroscopy

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Fishes are often reported with mercury contamination and it is accumulated mainly fromaquatic sources, so rapid identification of harmful mercury ions from both saline andfreshwater environment is crucial for Better Living. A Sulfopropyl methacrylate-basedhydrogel composite, incorporated with carbon dot derived from fish skin and carboxy methylchitosan (CMCS), was used as sensing probe towards mercury under different salineconditions. The composite was formed by interacting the carbon dot with CMCS - hydrogelthrough C-N, conjugated double bond and carboxyl groups as evidenced by Fourier transforminfrared spectroscopy. The cyclic voltammetry exhibited good correlation in analyte vsconcentration. In the present study application of electrochemical impedance spectroscopy (EIS) data as a tool to sense the analyte vs concentration of Hg^{2+} in the saline environment.EIS data of varied frequencies in real and imaginary impedance/ intersection angle betweenhigh and low frequency domain / Randles equivalent circuit model data vs concentration ofthe Hg^{2+} were examined. The results were compared with different R_2 values and suggested optimum ways of fitting the data for sensing experiments. The results indicated that EIS is apotential tool for apply in the electrochemical sensing studies.

Key words: Mercury sensor, carbon dot, carboxymethyl chitosan, hydrogel, sulfopropyl Methacrylate

Synthesis of High-Quality 3D Graphene on Cast Catalyst by Chemical Vapor Deposition

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Keywords: 3D Graphene, Nickel Powder, Slurry, Chemical Vapor Deposition

High metal-graphene junction contact resistance and sheet agglomeration greatly reduce the efficacy of graphene-based devices in industrial applications. We present here a unique approach to grow interconnected graphene layers, known as 3D graphene via thermal chemical vapor deposition (CVD). The process is scalable and the 3D graphene so obtained, is amenable to be used as such in varied applications without the worry of sheet re-stacking. Nickel powder, formed into slurry and then cast into a solid template has been used as a catalyst for the graphene growth. This method is much more economical and scalable compared to the costly nickel foam used elsewhere. Characterizations show that the synthesized 3D graphene is free of defects, extremely light weight, has rich porosity and a large surface area. This shows a promising potential for use of the as synthesized 3D graphene in electrochemical and membrane applications.

(a) (b)

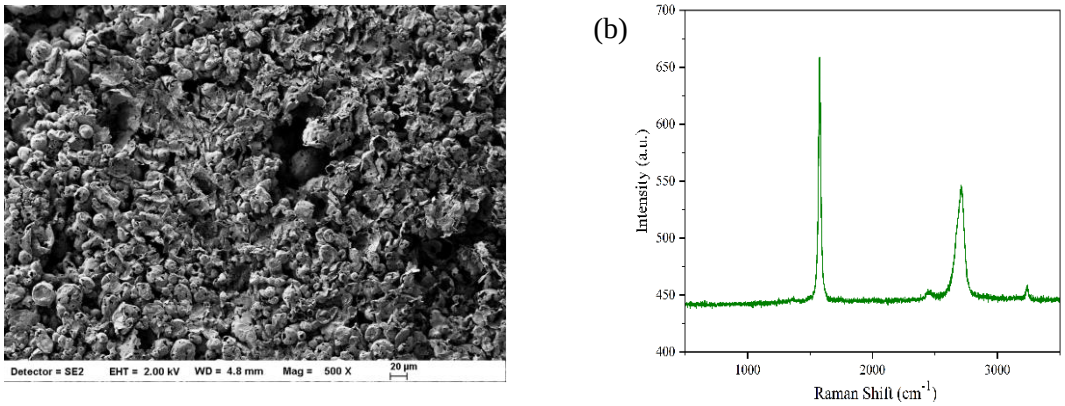

Fig. 1: (a) SEM image of the 3D graphene sample (b) Typical Raman spectra of the 3D graphene sample

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Facile Fabrication of superhydrophobic surfaces by Stereolithography modified with ZnO nanoparticles

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Superhydrophobic, Stereolithography, Nanocomposites, Zinc oxide, Self-cleaning surfaces.

Stereolithography is a fast additive manufacturing technique used to create complex parts with intricate geometries. Wide variety of material selection and high resolution can be used to make functional parts such as superhydrophobic surfaces. Various materials have been studied to improve the functionality of 3D printing. However, the fabrication of such materials is not easyas it is quite expensive. Also, we need superhydrophobicity only on the surfaces. In this work, we have used a commercially available SLA printer and its photopolymer resin to make different patterned surfaces, and a low surface energy coating with hierarchical roughness realized by a drop casting process with ZnO nanoparticles and Tetraethyl orthosilicate (TEOS). The wettability studies of created superhydrophobic surfaces were evaluated by means of static contact angle and rolling angle measurements. The effect of different temperatures and concentration of the ZnO-TEOS coating preparation on contact angle were studied. The effects of different patterns such as pyramids and pillars on contact angle were also studied. These surfaces exhibit an ultrahigh static water contact angle $\theta \simeq 160 \pm 2$ and a low roll-off angle of 5 0 for water droplets. This process can be easily applied with an SLA 3D printer and photopolymer resin for many applications such as self-cleaning and microfluidics [1-4] .

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Iron-based Hybrid Phosphonate material for Chemical Fixation of CO_2 into Cyclic Carbonate

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Keywords: Nanomaterials, cyclic carbonate production, polycarbonate production, and epoxide.

The efficient conversion of CO_2 into value-added products at ambient conditions is crucial for eco-friendly and sustainable catalysis. Today large attention has been made to promote the environmentally hazardless schemes based on CO_2 fixation reactions. One of the useful chemical transformations of CO_2 is its cycloaddition to epoxides for the synthesis of organic cyclic carbonates, which is highly demanding in polymers. These are essential starting materials for the synthesis of organic fine chemicals and pharmaceuticals in biomedical research. These cyclic five-membered organic carbonates are used as precursors of several polymeric compounds, aprotic polar solvents and electrolytes for the rechargeable batteries. Designing a competent and novel catalytic system is challenging for fruitful utilization of CO_2 to mitigate the global warming caused by industrialization, unrestricted use of fossil fuels, and other human activities. Metal phosphonates are the rising star for highly efficient catalysis and several studies prove their potential for CO_2 cycloaddition. On the same note, we report organic-inorganic hybrid iron phosphonate (FePPA) nanomaterial via high intensity probe sonicator. which further confirmed by various characterization techniques like FT-IR, XRD, SEM, TEM, etc. For CO_2 fixation a process was set-up for the conversion of CO_2 into cyclic carbonate by using FePPA catalyst which performed in pressure gauge reactor at temperature 100ºC for 24 hours at 5 bar pressure. FePPA shows outstanding catalytic activity and selectivity for cyclic carbonate without any co-catalyst, beside this it's also so an excellent recyclability. The results show 97% of conversion and 94% selectivity for cyclic carbonates with 6% selectivity for polycarbonates.

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PROCESS OPTIMIZED BIOMASS CARBON FILM ELECTRODE FOR CAPACITIVE DEIONIZATION BASED DESALINATION

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Capacitive deionization (CDI) is an emerging technology for low cost and energy-efficient water desalination to produce potable water from the brackish water source. In this study, micro and nano porous biomass carbon has been synthesized from biomass by an optimized process and used as an active material for preparation of the film electrode to be used in the CDI cell. The biomass carbon electrodes were electrochemically characterized by cyclic voltammetry (CV) and electrical impedance spectroscopy (EIS) while the material characterization was done with scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM/EDX). CDI based desalination experiment were carried out using the derived biomass carbon electrodes for 1000 ppm sodium chloride feed solution operating at the cell potential range of 1-1.2V and displayed satisfactory salt absorption capacity. The hydrophilic nature of the derived biomass carbon enables the interaction of hydrolyzed ions in water with the derived biomass carbon surface and reduces electrode-water resistance. The oxygen containing groups in derived biomass carbon store pseudo charge making it useful for CDI. This research demonstrates the feasibility of engineering and exploring biomass-derived biomass carbon as a low-cost, sustainable electrode material that can contribute to the creation of the circular economy.

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Structural and photoluminescence properties of green synthesized ZnO NP's from Calotropis Gigantea leaves

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In present work, structural, morphological and optical properties of green synthesized ZnO nanoparticles have been studied. ZnO nanoparticles were synthesized by plant extract method using a Calotropis Gigantea leaves. The obtained precipitance was annealed at 350°C in air atmosphere to achieve the crystallization. Subsequently prepared sample were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray (EDX), Fourier transform infrared spectroscopy (FTIR), and photoluminescence. The results reveal that the formation of hexagonal phase of ZnO NP's without ant impurities. PL emission band observed in the UV to visible range. It was found that the strong PL band at 403nm and 468nm in violet to blue region. The obtained results demonstrate the cost effective and ecofriendly high purity hexagonal ZnO nanocrystals and have potential application in optoelectronics and use as biomaterials applications against antibacterial agents. The possible mechanics have been discussed in details.

Keywords: - ZnO NPs, Green synthesis, Photoluminescence, Structural, optical properties.

Functionalised zirconium phosphate based nanoporous material for conversion of CO_2 into cyclic carbonates

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Keywords: Nanomaterial, cyclic carbonate production, polycarbonate production, epoxide.

The excessive combustion of fossil fuels and the release of effluent gases have resulted in a steadily rising CO_2 gaseous accumulation, endangering the ecosystem worldwide. The effective and ecologically friendly conversion of CO_2 into high-value chemical compounds is currently a topic of discussion in both the academic and industrial worlds. One of the effective methods for CO_2 fixation is the conversion of epoxides to cyclic carbonates using CO_2. On the same note, herein we report Zirconium phosphate-based functionalized inorganic material using hydrothermal method followed by reflux method. The roughly hexagonal flake-like 2D layered inorganic material was first exfoliated into the single-layered structure to expose their acidic sites and then functionalized with amine based organic moieties which show the slightly restacking of nanolayers. As-synthesised functionalized material shows good catalytic activity for the conversion of epoxide to cyclic carbonate using CO_2 in the presence of co-catalyst. Functionalized zirconium-phosphate has both acidic and basic sites; acidic sites are due to presence of –OH group of zirconium phosphate and basic sites are due to amine group of organic moieties. Due to presence of both sites it can be assure that it shows good catalytic activity for CO_2. Initially, it shows almost 78% of conversion and 70% selectivity for cyclic carbonates and 30% selectivity for polycarbonates.

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RATIONAL FABRICATION OF V_2O_5 NANORIBBONS FOR SUPERIOR ELECTROLYTE-CAPACITOR

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V_2O_5 has piqued the interest of the scientific community due to its unique properties such as layered structure, variable oxidation states, low cost, ease of availability, and moderate toxicity to humans. In the present study, the nanoribbons structure of V_2O_5 was prepared using a single-step hydrothermal route. The phase purity and crystal structure were investigated using powder XRD method whereas, elemental composition was investigated by XPS and EDAX. The chemical structure and bonds formation was investigated by FT-IR and RAMAN spectroscopy. The surface morphology and cross-section were determined by FEG-SEM and TEM. The length of the nanoribbon in the range of 5-6 micrometers with a width 300-500 nm. The findings of the analytical studies are consistent with the proposed formation plan. The electrochemical properties of vanadium oxides are significantly affected by the morphology and structure of the synthesized material. The electrochemical investigation of the synthesized nanoribbon was carried out in an aqueous KCl and LiCl electrolyte. The synthesized nanoribbon exhibits the highest specific capacitance about 140 F/g at 5 mv/s and shows tremendous cyclic stability of about 40% capacitance retention over 2000 cycles. Cyclic stability and high reversibility in nanoribbon structure were attributed to the advantageous nanoribbon structure of V_2O_5, which provides easy passage to electrolyte ions into the layered structure of the synthesized material. Thus, reduces the stress generated during the electrochemical reaction, slows down the electrode dissolution process, and ultimately results in excellent cycle life.

KEYWORDS: Supercapacitor; Hydrothermal; Cyclic Voltammetry.

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Influence of metal oxides addition on the physico-mechanical and biological behaviour of 13-93B3 borate bioactive glasses

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Soft tissue wounds in both humans and animals are exhibiting a significant ability to heal when treated with melt-derived bioactive glasses with a borate 13-93B3 composition. Metal oxides dopants

in borate 13-93B3 bioglass can help mend soft tissue wounds and bone defects, but little is known about how they function and are delivered. In the present study, Borate based 13-93 B3 bioactive glasses containing Fe_2O_3, MnO_2 and (Fe_2O_3+MnO_2) were prepared by the melt quench method. These glasses were submerged in SBF solution for varying lengths of time, and bioactivity was assessed using the FTIR, XRD, pH, and SEM techniques. The weight loss method was used to assess in vitro corrosion. It was found that raising the contents of Fe_2O_3 and MnO_2 improved the bioactivity. Density and mechanical properties such as flexural strength, compressive strength, etc. were also improved with increasing the dopants concentration. Borate glasses containing Fe_2O_3 and MnO_2 were discovered to degrade more slowly than the parent borate glasses 13-93 B3. These dopants glasses exhibit good in vitro bioactivity because they have minimal chemical durability. The excellent in vitro bioactivity of these modified borate glasses to produce hydroxyl apatite makes them potenial candidates for bone tissue engineering applications.

Keywords: Invitro bioactivity, hydroxyl apatite, SBF, In vitro corrosion, bone tissue engineering

Nanostructured Co-doped $BiVO_4$ for Efficient and Sustainable Photoelectrochemical Chlorine Evolution from Simulated Sea-Water

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Keywords: Hydrogen, Water splitting, Overpotential, Sustainability, Chlorine.

The co-production of hydrogen and chlorine from sea-water splitting could be a potential, sustainable and attractive route by any methods. However, the challenges to overcome are many, and critically the sustainability and operating potential of the electrocatalyst. In the present work, we report on Co-doping in the $BiVO_4$ (Co-BV) crystal lattice and employed the same as photoanode; Co-BV exhibits a photocurrent of 190 µA/cm^2 at 1.1 V vs RHE (reversible hydrogen electrode) in acidic sodium chloride solution (pH 2.3) under one sun illumination. The best performing photoanode, with 0.05 mol% of Co doping (0.05 Co-BV), selectively produce active chlorine with 92% Faradaic efficiency at 1.1 V vs RHE by successfully suppressing kinetically sluggish oxygen evolution reaction (OER) and stability of the catalyst has been demonstrated up to 20 h. This is the lowest operating potential reported for chlorine evolution reaction (CER), so far. Overpotential required for CER with 0.05Co-BV is lower than OER, which leads to selective CER at 1.1 V (vs RHE). Co-doping into the $BiVO_4$ lattice decreases the charge transfer resistance and enhances the CER kinetics due to its structural and electronic integration with BV lattice. We demonstrate that Co-doping also improves the life time of the charge carrier and the same enhances the current density of CER and sustainability of the catalyst.

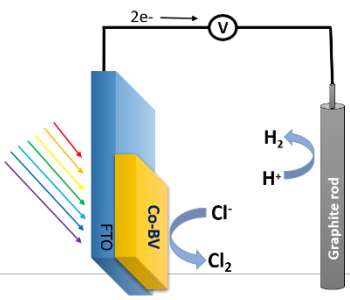

Fig. 1: Structurally and electronically integrated Co-doped $BiVO_4$ exhibits sustained HClO formation from photoelectrochemical salt-water splitting at 1.1 V in visible light.

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Inderjeet chauhan is a DST-INSPIRE fellow, currently pursuing his Ph.D. in chemistry with Dr. C. S. Gopinath at CSIR-NCL, Pune. My thesis work based on Energy conversion through photo-electrocatalysis to value-added products and my research interests are on the design the photo and electrocatalytic reactor for the high yield conversion.

Amine-Free Synthesis of High-Quality Cesium Lead Halide ($CsPbX_3$) Perovskite Nanocrystals for Optoelectronic Applications

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The extensive applications of lead halide perovskite nanocrystals are still hampered by poor stability in ambient conditions. Oleic acid and oleylamine are the most commonly used ligands in colloidal $CsPbX_3$ (X= Cl, Br, I) synthesis. The oleylamine plays a dual role as it stabilizes the surface which disturbs the colloidal stability in the long run. In this presentation, I will discuss our work on the open-atmospheric, facile, efficient, completely amine-free synthesis of cesium lead bromide perovskite nanocrystals using a novel bromine precursor, bromopropane. The reaction mechanism follows a trioctylphosphine/oleic acid-mediated surface passivation route, which provides an amine-free reaction environment to stabilize the ligand capping on the PNC's surface. The PLQY can maintain 83% of their initial one even after 120 days. I will discuss the impact of $CsPbBr_3$ perovskite nanocrystals with the three different surface chemistries on the excited state interactions with the standard hole acceptor phenothiazine molecule. We have calculated the photoinduced electron and hole transfer (PET and PHT) from the steady PL-lifetime decay measurements. In the amine-free PNCs case, PET is four times, and PHT is six times higher than the conventional amine-capped ligands. These results highlight the impact of surface chemistry on the excited state interactions of $CsPbBr_3$ PNCs and conclude that amine-free PNCs could be an ideal candidate for photocatalytic reactions.

KEYWORDS: *$CsPbBr_3$ Perovskite nanocrystals; Bromopropane; Amine-free; Photoinduced Electron and Hole Transfer.*

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Analysis of *CARD14* gene SNP and corresponding NF*κ*B dependent cytokine expression in Kashmiri psoriasis patients

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Keywords: (Psoriasis, SNP, NF*κ*B, cytokine)

Introduction: Psoriasis is a chronic multifactorial immune mediated skin disorder that affect nails, joints and mucosal surface. The disease is characterized with overt turnover of keratinocytes due to extensive proliferation, differentiation and inflammation resulting in red erythematous itchy, scaly skin plaques (1). The disease is known for its wide geographical variations due to genetic susceptibility, immunogenic and some environmental factors (2) The cause and underlying etiology of psoriasis is still unknown. Multiple psoriasis susceptibility (PSORS) loci have been identified, among them PSORS2 (chromosome17q25) (9) was found to be due to gain-of-function mutations in the CARD14 gene (Caspase Recruitment Domain-Containing protein 14) also known as CARD-containing MAGUK protein2 (CARMA2). CARD14 is primarily expressed in keratinocytes and in mucosae. Recent studies have illustrated that this scaffold protein plays a crucial role in the human skin. In normal circumstances CARD14 remains in autoinhibitory mode, once activated by its corresponding signalling molecule it recruits interacting partners BCL10 and MALT1 to form the so called CBM complex which activate the inflammatory transcription factor NF-κB that regulates proinflammatory gene expression. Overexpression of the pathogenic missense CARD14 variants in primary keratinocytes resulted in enhanced NF-κB activation and increased production of several psoriasis-associated chemokines. Therefore, it is generally believed that excessive activation of NF-κB and expression of NF-κB-responsive genes in keratinocytes by psoriasis-associated CARD14 variants can initiate an inflammatory reaction that attract immune cells to the skin and culminates in psoriasis development (3). Number of inflammatory cytokines have been shown to be elevated in lesional psoriasis skin, and the serum concentrations of a subset of these also correlate with psoriasis disease severity (4). Therefore, it has been proposed that elevated levels of circulating pro-inflammatory cytokines found in the serum of patients, foster these systemic abnormalities in secondary organs (5). It seems reasonable to assume that CARD14 gene mutation in the hotspot exon (CARD and coiled coil domain) activates NFκB, which in turn increases Pro inflammatory cytokines production that culminates in psoriasis development and may act as a risk factor for comorbidities associated with psoriasis also.

Aim: To analyse CARD14 single nucleotide polymorphism (SNP) association with its corresponding cytokine expression in Kashmiri psoriasis patients.

Materials and methods: Clinically confirmed 100 psoriasis patients were considered for the experimental work plan after getting ethical clearance from the concerned board, while as healthy, age and gender matched individuals who voluntarily participated were recruited as controls. Whole blood was collected in K_2 EDTA containing vials and the genomic DNA was extracted from peripheral blood lymphocytes by using salting out method DNA extracted and was stored at -20^{o}C until further processing. The quantity and quality of DNA was determined by absorbance at 260nm and 280 nm in a Nanodrop and by running on 0.8% gel Target DNA fragment was amplified by PCR, using specific forward and reverse primers as per available literature. In order to analyze the association of CARD14 gene variant with psoriasis, the amplified products were sequenced and compared with control. RNA extraction will be done soon after blood collection and Expression analysis will be done by Quantitative RT-qPCR. RNA will be extracted by Trizol method which will then be stored for long periods of time, at -80°C. RNA concentrations will be determined using a Nano Drop Spectrophotometer. Successful extraction of RNA will be confirmed by 1% agarose gel electrophoresis. Equal quantities of total RNA will then be reverse transcribed using First-Strand cDNA synthesis kit in reactions containing total RNA. PCR product analysis was done by 1.5% agarose gel electrophoresis. Samples without enzyme in the reverse transcription reaction (non-RT controls) will be used as negative controls. Unspecific signals caused by primer dimers will be excluded by no template controls and by dissociation curve analysis. Specific primer pairs for RNA will be designed. Gene expression will be analysed by SYBR Green RT-qPCR.

Results: Considerable number of patients have been seen to have SNP at a particular exon of CARD14 gene.

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Industry waste HCl utilization for the production of chlorine by using green electrochemical approach

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Keywords : HCl electrolysis, chlorine production, oxygen depolarisation cathode.

The demand for chlorine is increasing sharply because chlorine is one of the important chemical used in industries for the manufacturing of important chemicals, especially for the polymer industry. With the production of these chlorine-based polymers excess HCl is produced as a waste product. Chlorine can be recovered by this wasted HCl by electrochemical method[1]. Conventionally in HCl electrolysis hydrogen is evolved at the cathode and chlorine at the anode and the theoretical cell voltage required for these reactions is 1.36V vs RHE.

Cathode:	$2H^+ + 2e^- \rightarrow H2,$	E= 0.00 V vs. RHE
Anode:	$2Cl^- \rightarrow Cl2 + 2e^-$	E= 1.36 V vs. RHE
Overall:	$2HCl \rightarrow H2\ (g) + Cl_2\ (g)$	E= -1.36 V vs. RHE

Overall cell potential can be decreased by changing the cathode from hydrogen evolving to oxygen depolarisation cathode (ODC). And by using ODC cathode cell voltage reaches upto -0.13V vs RHE according to the below reaction:

Cathode:	$4H^+ + 2O2 + 2e^- \rightarrow 2H_2O\ (l)$	E= 1.23 V vs. RHE
Overall:	$4HCl + O_2 \rightarrow 2Cl_2 + 2H_2O\ (l)$	E= -0.13 V vs. RHE

Therefore, by introducing ODC overall cost of Cl_2 production decreases[2]. Herein, we have designed a stable, active and cost-effective bifunctional catalyst for HCl electrolysis for ODC and chlorine evolving anode.

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"SeqA mediated cohesion modulates the kinetics of DNA double strand break repair in E. *coli.*"

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Keywords: *E. coli,* Cohesion, SeqA, and DNA repair.

Across the domains, propagation of life requires coordination in cellular mechanisms like DNA replication, repair, segregation & cell division. These endogenous cellular mechanisms along with other exogenous factors (UV radiation, starvation and genotoxic chemicals) impose a threat on the integrity of genomicDNA; as DNA double strand breaks (DSB's). To maintain genomic integrity and clonal progeny, DSB's must be repaired with high efficiency and fidelity. In bacteria, majority of DSB's are repaired via homologous recombination (HR), which utilizes homologous intact strand as a

template. Recent studies have shown that *E. coli* genome experiences cohesion (co-localization of homologous strands post replication), which is positively regulated by the SeqA protein. Unlike eukaryotes, cohesion timing along the genome of *E. coli*, is patchy as few sites along the right arms of the replichore experience prolong cohesion (high cohesed locus) compared to rest of genome (less cohesed locus). Some other studies have shown that cohesion plays an important role in replisome stability and cohesion mutants are prone for spontaneous DSB's. However, it remains to be tested whether and how differential cohesion timing (patchy cohesion) play a role in locus-specific DSB repair.

In order to test the role of cohesion, we investigated site specific DSB repair (Locus specific DSB induced using ISce-1 endonuclease) along the genome of *E. coli*. Our data shows that, (A) both short-term & prolonged DSB's were efficiently repaired at higher cohesed loci, resulting in better cell survival compared to less cohesed loci. (B) Same amount of RecA-GFP foci accumulation and loss of copy number was observed at both high cohesed and less cohesed loci with-in 30-60 min. of DSB induction. (C) Disappearance of RecA-GFP foci is faster at high cohesed loci compared to less cohesed loci.

Band gap modification of few-layer MoS_2 by Swift heavy ion irradiation

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The unique electronic band structure properties of two-dimensional (2D) materials allow for a multitude of cutting-edge applications involving electrical and optoelectronic devices. Atomically thin 2D materials such as MoS_2 face major obstacles during synthesis and processing into precise electronic band gap properties adjustments. Few-layer MoS_2 films are synthesized using alkali halide (NaCl) and, ion beams have been used to modify the electronic band gap and result in subsequent absorption properties of few-layer MoS_2.

The band gap tuning in MoS_2 is highly desirable for optimizing their applications in solar cells, photodetectors, and optoelectronic devices. We have already shown the effect of biaxial strain on the structural, elastic, and electronic properties of MoS_2 [1]. In the present work, we are reporting 100 MeV Ni^{7+} ion irradiation-induced blue shift in MoS_2, with ion fluences of 1×10^{11} to 1×10^{13} ions/cm^2. The electronic energy loss of 100 MeV Ni-ions is 11.3 keV/nm, have been calculated from SRIM-2008 [2]. UV-vis spectroscopy shows the absorption peak shifts from 680 nm to 674 nm for the A-peak and from 630 nm to 624 nm for the B-peak.

Keywords: 2D-tansition metal dichalcogenide (2D-TMD), Band gap, Swift heavy ion (SHI), Chemical vapor deposition (CVD), Strain.

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Microstructure and Ferroelectric properties of barium titanate based ceramics.

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Keywords – Ceramics, Ferroelectric, Surface morphology, Liquid Phase.

Barium titanate ($BaTiO_3$), barium zirconate titanate Ba ($Zr_{0.10}Ti_{0.90}$) O_3, barium calcium titanate ($Ba_{0.85}Ca_{0.15}$) TiO3, and barium calcium zirconate titanate ($Ba_{0.85}Ca_{0.15}$) ($Zr_{0.1}Ti_{0.9}$)O_3 ceramics have been synthesized using a conventional solid-state reaction route. The homogenized ingredients of all compositions were calcined at 1250 ^oC for four hours and sintered at 1500 ^oC for 6 hours. The surface morphology of sintered ceramics has been investigated for all four compositions using a scanning electron microscope. The average grain size of the sintered barium titanate ceramics is found to be ~ 145 μm, indicating that the material has reached to the liquid phase at the sintering temperature. The grain size of barium zirconate titanate (BZT), barium calcium titanate (BCT), and barium calcium zirconate titanate (BCZT) ~ 4.41, 20.29 and 6.02 μm respectively. The Microstructure of Ca-doped barium titanate ceramics shows a diphasic region with two distinct grain size distributions. Temperature-dependent P-E hysteresis loop measurements have been done on BCT and BCZT ceramics from room temperature to 130 ^oC. Room temperature values of coercive field E_c and remnant polarization P_r for BCT ceramics are ~ 0.73 kV/cm and 4.2 μC/cm^2, and for BCZT ceramics the E_c and P_r values are ~ 0.82 kV/cm and 1.11 μC/cm^2 respectively.

Zr-MOF DECORATED ON PINEAPPLE DERIVED AC NANOSHEETS AS AN ELECTRODE MATERIAL FOR SUPERCAPACITOR

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The development of highly efficient and sustainable energy storage materials is an area of extensive research to meet continuously growing energy demands. Supercapacitors that employ highly efficient electrode materials are valuable alternatives to commercial capacitors. Metal organic frameworks have emerged as an interesting material due to their tunable pore size, and high surface area, but are

poorly conductive [1]. Therefore, synthesis of MOF composites with conductive materials, like carbon, is expected to exhibit improved electrochemical properties. Due to the low toxicity, high yield and facile synthesis at room temperature, Zirconium (Zr) based MOFs, are one among the foremost promising MOF materials to be used for practical energy applications. Also, use of pineapple waste derived activated carbon (containing heteroatoms e.g. N, O) as conductive material, instead of commercially available activated carbon, is a sustainable option. In this work, we have synthesized UiO-66 (a Zr-MOF) composite with pineapple derived activated carbon nanosheets (PLC) as an electrode material for the fabrication of supercapacitor [2, 3]. The overall procedure includes two steps: activation of carbon derived from pineapple waste and precise growth of UiO-66 into pores of as synthesized carbon nanosheets. The as-prepared UiO-66/PLC composites exhibited flake like morphology with crystals embedded in cavities with hierarchical porosity. The electrochemical study of the prepared UiO-66/PLC electrode in 1M H_2SO_4, exhibited a specific capacitance of 295.9 F g^{-1} at 2A g^{-1} and good cycling stability. This study emphasized the potential importance of 3D Frameworks and their combination with waste derived activated carbon as a strategy for enhancing the charge storage kinetics of moderately conducting MOFs.

Keywords: Zirconium, metal organic framework, pineapple waste, activated carbon.

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REGIONAL LANGUAGE TRANSLATOR

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Abstract- There are assorted dialects present all around the world and in nations as well. India is also a diverse country, with people from various cultures and dialects. The majority of individuals in India know just their primary language, which is their provincial language. They require a physical interpreter to relay their message.

In this project, we aim to translate a regional language text that is Tamil to English. So, the main idea behind this is to develop a system that works as a translator. It accepts scanned Tamil printed text and outputs it in English. Our system will process the scanned text and provide output. This app caters to travellers and students who will be visiting Tamil Nadu.

Aim & Objective

The local language communication in India is vital for effective developmental action.[1] Languages are important to people. People exchange meaning, communicate, and feel their sense of individual and communal identity through language.

A translator is a person who interprets a language and translates it into another language. Translators are fluent in at least two languages so they can communicate between people who speak different languages. You can translate written or spoken communication to help people who aren't multilingual communicate better.[2] The state has a 22.9% share of the total visits in 2020 and has been ranked first in domestic tourist visits in 2020 with over 140 million visitors.[3] The year 2019 was a notable year for India as it witnessed more than 10.93 million tourist arrivals.[4] Furthermore, Tamil Nadu received approximately 3.4 lakh foreign visitors last year. Translation plays a part in an increasingly globalised society by removing language barriers. Professionally speaking, translators serve as experts in intercultural communication, mediators, and a link between individuals.

The project aims to translate the scanned Tamil text to English text. Our system's goal is to provide an English translation of popular tourist destination's Tamil names. Therefore, the fundamental goal of this is to create a system that functions as a translator that translates Tamil text to English.

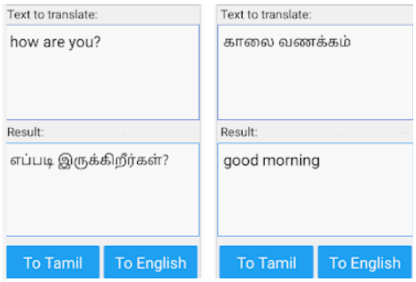

Fig.1: Tamil English Translator

The user may scan or click a picture on the board or text that contains the location's name, then the system would recognise the Tamil text and translate it to English before outputting it to the user.

Regional Language Translation System:

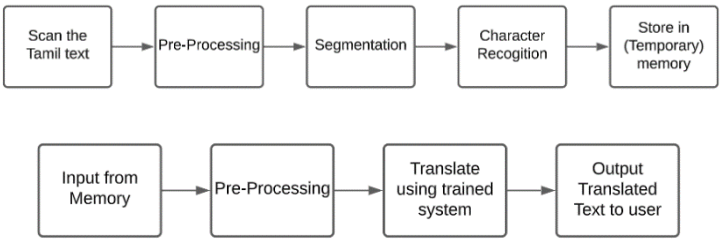

Fig.2: Language Translator

The user must scan the printed Tamil text using the phone's camera, which the system will then pre-process and break down into segments, then recognise the characters and store them in a temporary memory. The stored data is then pre-processed and translated by a trained system before being displayed to the user.

Conclusion:

The Regional language translator can scan any Tamil script to equivalent English text, we are primarily focusing on tourist places in Tamil Nadu which will help tourist to be able read and spell the places, by which navigation will be made easy. This system can be useful for tourists who travel to Tamil Nadu but are not aware of the local language. The system provides an interface where one can

scan an image of the tourist destination that he or she wants to translate. The model built using Machine Learning Algorithms. The system helps eliminating the need for a physical translator and making the tourist self-sufficient in terms of knowing where to go. The project is intended to be further developed for other South Indian Languages.

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COPPER BASED MAGNETIC BEADS AS AN EMERGING CATALYST FOR THE SYNTHESIS OF 1,4-DISUBSTITUTED 1,2,3-TRIAZOLES IN AQUEOUS MEDIA

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Keyword:1,2,3-triazole; Magnetic beads; Recyclable.

A novel copper embedded magnetic beads-based catalyst was prepared and utilized as an efficient catalyst for the copper catalysed [3+2] cycloaddition reaction of aryl azide and terminal aryl alkynes via click chemistry using water as a solvent. The catalyst works with better efficiency under ultrasonication and microwave conditions with yield varying from 85-92%. The catalyst has main advantage of being magnetically separable and easily recyclable. This sustainable triazoles synthesis is distinguished by its broad substrate scope, operational simplicity and easy gram scale supply of a functionalized product for subsequent synthetic application.

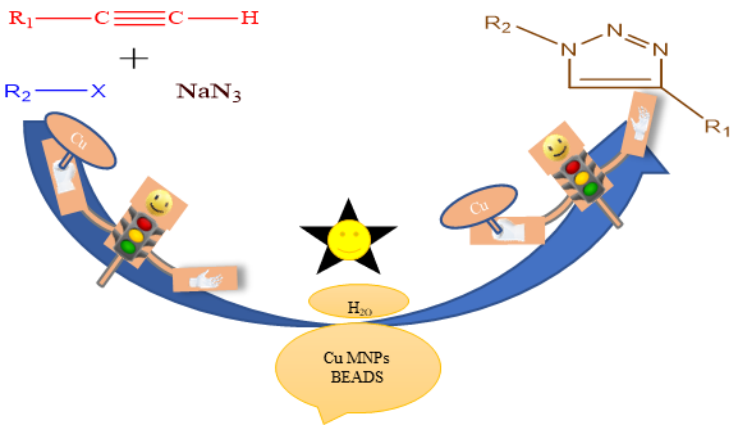

Fig. 1: Click chemistry: A transformable block for the synthesis of 1,2,3-riazole

Profile: Neetu Mev (B.Sc. from MGSU Bikaner; M.Sc. from Dept. of Chemistry University Of Rajasthan, Jaipur)

Oxidation of HOSO by O_2: a key reaction deciding the fate of HOSO in the atmosphere

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In the work, we have studied the oxidation of HOSO by O_2 employing quantum chemical and kinetic calculations. This work reveals that HOSO+$O_2$is a barrierless reaction which proceeds through a stable hydrogen-bonded complex. The estimated atmospheric lifetime of HOSO in the presence of $O_2$is found to be several orders of magnitude less compared to the other oxidation paths of HOSO, suggesting that the oxidation of HOSO by O_2 might be the most dominant oxidation path of HOSO in the atmosphere.

Starch hydrogels based on silver nanoparticles synthesized with botanical extracts

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Keywords: Silver nanoparticle, hydrogel, antibacterial, antifungal, diffusion.

Bio-nano composite hydrogels have gained special interest due to their wide range of applications in drug delivery systems[1], biosensors[2], scaffolds etc. Since hydrogels have been found to be better choice as they can immobilize also stabilize nanoparticles. We have developed non-toxic starch hydrogels containing silver nanoparticles, and studied their antimicrobial activity. Silver nanoparticles

were synthesized from *Embelica officinialis* extract. Nanoparticle size was quantified with scanning electron microscopy images and UV-Visible spectroscopy. SEM images showed uniform dispersion of silver nanoparticles in the hydrogel matrix. These silver-nanoparticle containing starch hydrogels shows excellent antifungal activity to plant pathogen *Magnaportha oryzae* and no growth was observed for 10 days in compared to the control hydrogel, made of only starch. Antibacterial activity was also studied for gram-negative bacteria *Escheriachia coli* with (4.78 cm^2) zone of inhibition and gram-positive bacteria *Staphylococcus aureus* using diffusion assay with antibiotic mixture. Much larger zone of inhibition (16.32 cm^2) was obtained for silver-nanoparticle based starch hydrogels compared to controls with starch hydrogels, showing good release efficiency of these hydrogels in presence and absence of silver nanoparticles. Surface antibacterial activity of silver nanoparticle based hydrogels was also studied for *Staphylococcus aureus*. The fabricated hydrogels are environmentally friendly and non-toxic can be a suitable replacement for synthetic chemical-based hydrogels which use a toxic glutaraldehyde crosslinker.

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Analysis of bio-energy prospects from lignocellulose agricultures waste with FTIR and machine-learning

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Keywords: Lignocellulose, FTIR spectroscopy, machine learning, enzymatic digestion.

Lignocellulose waste is composed of cellulose, hemicellulose and lignin that can produce biofuel such as bioethanol, bio-butanol and even third generation biofuels after separation with suitable pre-treatment. It is very challenging to break the strong cellulose, hemicelluloses and lignin structure. Hence, it is our need to develop techniques for analyzing non-invasively the composition of lignocellulose waste for assaying their suitability for bioenergy production. FTIR spectra were obtained about 30 different lignocellulose wastes from crops after harvest and its constituents – lignin, cellulose and hemicelluloses, obtained by separation with deep eutectic solvents. Linearly dependence of concentration on absorbance was observed through FTIR spectra of cellulose and lignin. These FTIR spectra were analyzed through machine learning models with algorithms such as linear discriminant analysis, decision tree, and random forest algorithms. Best classification accuracy obtained through random forest algorithm with accuracy as 0.75. Convolutional neural network modelling with Bayesian regularization training algorithm using data from FTIR spectra of different lignocellulose resulted in better representation with root mean square error as ~ 0.11. Different pre-treatment methods caused structural changes in cellulose and that is analyzed with peak heights of FTIR spectra and correlated with efficiency of enzymatic hydrolysis to form glucose where observed that deep eutectic solvent in green pre-treatment method greater improves cellulose accessibility to enzymes with 38% glucose yield compared to acid and alkali pre-treatments.

Ni-Co based Selenide for High Energy Density All-Solid-State Asymmetric Pseudocapacitors

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The incredible advancement of portable electronic devices has inspired researchers to create highly efficient electrochemical energy storage systems.[1] Because of their higher electrical conductivity and lower band gap, binary transition metal selenide-based nanostructures have gotten a lot of attention in this context.[2] In light of this, we present a simple anion exchange hydrothermal synthesis procedure for creating bimetallic nickel cobalt selenide ($NiSe_2$-$CoSe_2$) nanostructures for use in all-solid-state asymmetric pseudocapacitors. The detailed physicochemical characterization of material reveals lower crystalline characteristics, a unique porous microstructure, and significant bonding between metal and selenium. The electrochemical analyses of the $NiSe_2$-$CoSe_2$ electrode material showed excellent electro-kinetic reversibility, supercapacitive charge discharge characteristics and negligible charge transfer resistance (R_{ct}).[3] Moreover, all-solid-state hybrid supercapacitor device assembled using $NiSe_2$-$CoSe_2$ as positive electrode material, nitrogen doped reduced graphene oxide (N-rGO) as negative electrode and PVA-KOH gel as electrolyte/separator reveal good redox behavior, excellent charge-discharge properties with negligible voltage (IR) drop and lower impedance characteristics. The solid state hybrid supercapacitor device ($NiSe_2$-$CoSe_2$||N-rGO) showed energy density of rechargeable batteries and power density of ultra-capacitors. The bimetallic $NiSe_2$-$CoSe_2$ is proposed as an excellent electrode material for next generation all-solid-state asymmetric pseudocapacitors.

Keywords: Ni-Co based selenide, electro-kinetic reversibility, and energy and power density, all-solid-state asymmetric pseudocapacitor

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External Electric Field as a Catalyst for Ammonia Formation Via Reaction Of N_2 and N-Hetrocyclic Carbene

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Keywords: Quantum chemical calculations, N-heterocyclic carbene, external electric field.

Based on quantum chemical calculations, we have investigated an external electric field (EEF) as a potential catalyst for ammonia formation from the reaction of N_2 with N-heterocyclic carbene. It is shown that without any catalyst, the reaction of N_2 with N-heterocyclic carbene is a high barrier reaction, but by choosing the EEF at a suitable direction and strength, the barrier for the reaction can be reduced from ~17.10 kcal mol^{-1} to ~0.97 kcal mol^{-1}. It was also shown by computing the reaction rate that in the presence of EEF, the rate of title reaction can be increased by trillion-fold. Therefore,

N_2 with N-heterocyclic carbene in the presence of an external electric field give the possibility of a very efficient way of making ammonia from nitrogen.

In this work, plant leaves were used as a stabilizing, capping, and reducing agent for the synthesis of ZnO-CuO nanocomposite and the precursor used in the synthesis of ZnO-CuO nanocomposite was Zn $(NO_3)_2.6H_2O$ and Cu $(NO_3)_2.3H_2O$. ZnO-CuO nanocomposite were characterized using Fourier Transform InfraRed (FT-IR) spectroscopy, X-Ray Diffraction (XRD) spectroscopy, UV–Vis Diffuse Reflectance Spectroscopy (DRS), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray (EDX) spectroscopy and Field Emission Scanning Electron Microscopy (FE-SEM). The band gap energy of ZnO-CuO nanocomposite was determined by Tauc plot using absorbance data, which was found to be 2.98 eV. Synthesized ZnO-CuO nanocomposite utilized in the photocatalytic degradation of Methylene Blue (MB) dye, showed excellent 99.62 % photocatalytic degradation efficiency and followed pseudo-first-order kinetics.

Magneto-transport properties of Bi_2Te_3 topological insulator and $La_{1.8}Pr_{0.2}CoFeO_6$ ferromagnet

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In condensed matter physics, strong spin–orbit interaction with symmetry breaking gives rise to many exciting phenomena. A recent example is the existence of skyrmions, which are observed in thin and multilayers system and non-centrosymmetric bulk systems which lack inversion symmetry. Magnetic skyrmions are small swirling topological defects in the magnetization texture (can be considered as a knot of twisting field lines). They are vortex-like spin textures with small size, nontrivial topology, and high mobility, making them great promise as data carriers for high-density, high-velocity, and low-energy-consumption memory devices. Skyrmions show the topological Hall Effect and non-collinear magnetoresistance. Recent studies show that a topological insulator (TI) interfaced with a magnetic insulator (MI) may host an anomalous Hall Effect (AHE), a quantum AHE, and a topological Hall Effect (THE). In this regard, the topological insulator (Bi_2Te_3) is interfaced with a magnetic insulator ($La_{1.8}Pr_{0.2}CoFeO_6$ (LPCFO)). Topological insulator Bi_2Te_3 shows spin Hall Effect and has large magnetoresistance. LPCFO exhibits a ferromagnetic insulating ground state near room temperature, large magneto–dielectric effect (MDE), and transition temperature near 270 K. The results will be presented at the conference.

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Electrodeposited MoS_2 films as low-cost alternative counter electrodes for efficient dye sensitized solar cells

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The role of a counter electrode in dye sensitized solar cells is to transport electrons from external circuit to the electrolyte and subsequently catalyse the reduction of redox electrolyte in order to regenerate the dye molecules. In the present work, we have examined the potential of electrodeposited MoS2 films as alternative CE to replace conventionally used expansive Pt electrode. Devices fabricated with MoS2 CEs have shown efficiency ~6%, which is comparable with devices based on conventionally prepared Pt electrode. In addition, a significant improvement in short circuit current density (15%) has been observed for DSCs prepared using MoS2 CEs. The findings reveal that amorphous MoS2 have significant potential to replace Pt CE in DSCs.

RESULTS AND DISCUSSION:

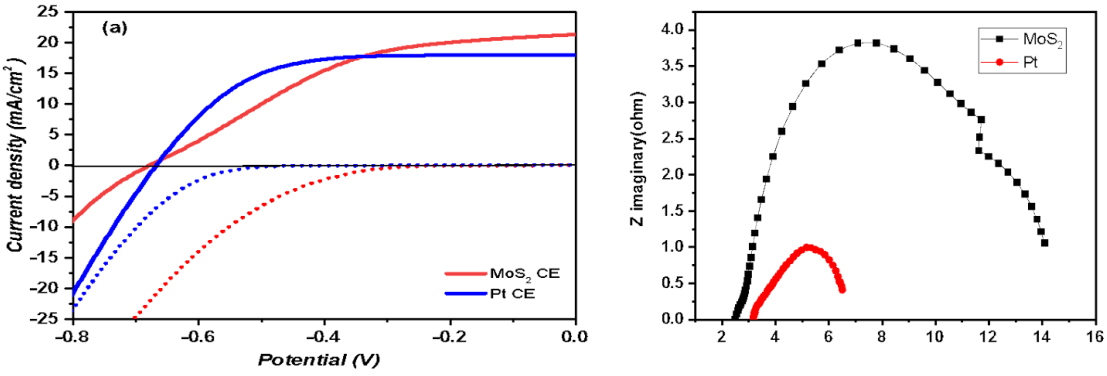

Fig. (a) Current density-Voltage curve and (b) EIS of DSCs under 1 sun illumination, for comparison data for DSC using Pt CE is also shown.

Photovoltaic parameters of DSSC

device	Jsc (mA/cm^2)	Voc (Volt)	Fill-factor	Efficiency	Rs (Ω)	Rw (Ω)	Chemical capacitance Cμ ($x10^{-4}F$)	Recombination life (ms)
MoS_2	21.3	0.68	0.425	6.17	2.4	~~5.36~~	~~5.4~~	~~29~~

					9			
Pt	**17.90**	**0.67**	**0.625**	**7.5**	**3.16**	**2.896**	**8.6**	**2.5 ms**

CARBON NANOTUBES AS ADSORBENTS FOR THE ADSORPTION OF PHARMACEUTICAL POLLUTANTS FROM WASTEWATER

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Large amounts of pharmaceutical products are been manufactured, consumed, and disposed of in the waterbodies which lead to huge pharmaceutical pollution. These compounds present in the water affect marine organisms and put ecosystems, drinking water, and human health at risk. The adsorption technique can be adopted for the removal of these pollutants as it requires less operation cost compared to other processes such as filtration, advanced oxidation technique, etc. In this study, carbon nanotubes (CNT) are used as adsorbents for the removal of these pollutants. Carbon nanomaterials are used as they have high adsorption capacity due to their large surface area and porosity. CNT modifications are also done to increase its adsorption capacities. In order to evaluate the effectiveness of carbon nanotubes in this capacity, various experimental parameters, including contact time, initial concentration, pH, temperature, and the dose of adsorbent have been investigated in this study. Characterization studies are also conducted for the adsorbents.

Keywords: Pharmaceutical, Wastewater treatment, Carbon nanotubes, adsorption, adsorption capacity.

ADSORPTIVE REMOVAL OF PHARMACEUTICAL POLLUTANT TETRACYCLINE FROM WATER USING ZnO DOPED CARBON NANOTUBES

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Large amounts of pharmaceutical products are been manufactured, consumed, and disposed of in the waterbodies which leads to huge pharmaceutical pollution. These compounds present in the water affect marine organisms and put ecosystems, drinking water, and human health at risk. The adsorption technique can be adopted for the removal of these pollutants as it is less laborious and requires less operation cost compared to other processes such as filtration, advanced oxidation technique, etc. In this work, carbon nanotubes are added to zinc oxide to help in the efficient adsorption of pharmaceutical pollutants. The surface area, mechanical characteristics, and dispersibility of CNT are all enhanced by ZnO doping. The produced ZnO/CNT nanocomposite had a removal effectiveness of 96% from the tetracycline solution after 15 minutes. Tetracycline solution was shown to be effectively removed at an acidic pH and at room temperature. In this investigation, a number of experimental

factors, including contact time, initial concentration, pH, temperature, and the dose of adsorbent, have been examined in order to assess the efficacy of ZnO/CNT in this capacity. Scanning electron microscopy, Fourier transforms infrared spectroscopy, and X-ray diffraction was used to characterize the nanocomposite.

KEYWORDS: Adsorption; Carbon nanotubes; Pharmaceutical; Tetracycline; Wastewater treatment.

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Fabrication of 2D transition metal oxides and their device applications

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Keywords: Transition metal oxides (TMOs), Molybdenum trioxide (MoO_3), Tungsten trioxide (WO_3), PVD, CVD.

The list of diverse 2D materials with congruent properties has been steadily increasing since the mechanical exfoliation of graphene in 2004 **[1]**, as evidenced by numerous studies **[2][3]**. There is currently a growing interest in dielectric materials and wide band gap semiconductor materials within *India* this catalog of 2D materials, due to their potential for optoelectronic applications that require both electrical conductivity and visible light transparency.

We utilized both PVD (Physical vapor deposition) and CVD (chemical vapor deposition) techniques to fabricate 2D Transition metal oxides (TMOs) such as MoO_3 and WO_3. These materials have been extensively studied for their remarkable applications in electronics, gas sensors, LEDs, photo, and electrochromic materials, among others. MoO_3 exists in two distinct structures: α-MoO_3 in orthorhombic form and β-MoO_3 in monoclinic form. Heating β-MoO_3 above 673K results in its conversion to the α-phase, which is the stable phase. There are two types of WO_3, namely monoclinic WO_3 and hexagonal WO_3. To grow multilayers of MoO_3 and WO_3 on SiO_2 substrates, we deposited molybdenum and tungsten thin films using physical vapor deposition (PVD) on different substrates. The deposited Mo and W thin films were then used as a source for chemical vapor depositions, and a hot plate was used to vary the temperature for growing the multilayers. The hot plate and CVD were

performed under ambient conditions, while the PVD was performed in high vacuum conditions. Thermal evaporation techniques are capable of producing single crystal forms.

The study investigated the properties of MoO_3 and WO_3 thin films using techniques such as X-ray diffraction (XRD), Scanning electron microscopy (SEM), I-V characterizations, and dielectric measurements. MoO_3 thin films were further characterized for crystal structure, impedance, orientation, surface morphology, and optical images using UV-Vis spectroscopy to determine light transmittance and emission spectra.

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An insight towards the photo-generation of H_2 and multifarious carbon fuel additive from biomass-derived ethanol: Boosting the bio-chemical economy

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Keywords: H_2 production, carbon nitride, 1, 1, di-ethoxyethane, photocatalysis, and biomass.

Unifying hydrogen (H_2) fuel production with value-added chemicals from biomass through semiconductor-mediated solar redox reaction is an extremely appealing and sustainable process to uproot the energy and environmental issues, cooperatively boosting the chemical economy. Phenomenal H_2 content and excellent chemical bond versatility make the biomass-derived ethanol an indispensable feedstock for the production of green H_2 fuel with value-added chemicals or fuel additive synthesis in a synergistic manner. Herein, Pt/UCN/Nb_2O_5-(2) photocatalyst, an organic-inorganic heterostructure was prepared and employed to promote the light-mediated co-production of H_2 and 1, 1, di-ethoxyethane (DEE) as fuel additive from biomass-derived ethanol solution via photocatalytic dehydrogenation (PD) pathway. As a consequence, the photocatalytic performance of the Pt/UCN/Nb_2O_5-(2) catalysts was scrutinized for DEE (506.6 µmol $h^{-1}g^{-1}$) and H_2 (558 µmol $h^{-1}g^{-1}$) production initially for 6 h under solar simulator light irradiation. Additionally, apparent quantum yield (AQE) for H_2 production (400 nm) and solar-to-hydrogen (STH) conversion efficiency were estimated to be 2.18 % and 0.04 % in 6 h, respectively.

Investigate the structural, Morphological and Optical Characteristics of the Triple Perovskite $La_3Ni_2SrO_9$

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Keywords: Ceramic Material, Crystal Structure, Scanning Electron Microscopy, Rietveld Refinement, Optical Properties.

This study investigates the structural, morphological and optical properties of the Triple Perovskite $La_3Ni_2SrO_9$ synthesized by using the solid-state reaction route. The crystalline structure properties were studied by Using X-Ray diffraction and Field emission scanning electron microscopy (FESEM) was used to study the morphological properties of the material. The Optical properties of the material were studied by using UV-Spectroscopy. From the XRD data we have observed that the material crystallizes is the monoclinic Perovskite belonging to the space group *Pnma* (#62). The optical properties were characterized through UV-Visible spectroscopy, and the bandgap of the material was estimated to be 2.46 eV. The results suggest that $La_3Ni_2SrO_9$ exhibits strong absorption in the UV region. The study provides insight into the fundamental properties of this material, which may inform future research on its potential applications.

Structure, magnetic and transport properties of nano-crystalline thin films of NiCoCrFePd high entropy alloy

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Keywords: high entropy alloys, thin film, magnetic properties, transport properties, spin gapless materials.

High entropy alloy (HEA) films having applications in various fields ranging from harsh environments to electronic devices. [1,2] Nanostructured high entropy thin films of Heuslers alloys found promising materials for room temperature spin gapless semiconductors. [3-5] E-beam evaporation technique is used to synthesize the thin film of NiCoCrFePd HEA at room temperatures and subsequently annealed at different temperatures. Further, the temperature dependent XRD revealed strongly (111) oriented face center cubic (FCC) structure of NiCoCrFePd thin films with no phase transformation and excellent stability down to 30 K temperature. Rutherford backscattering spectroscopy (RBS) along with energy dispersive X-ray (EDX) spectroscopy confirmed equiatomic composition with small deviation (±2 at. %) from the equiatomic target. Elemental mapping indicated the homogenous distribution of constituent elements with no phase segregations. M-T measurement confirms the ferromagnetic nature at room temperature in all the samples with the critical temperature

(T_C) decreases from 431 K to 375 K upon annealing. The temperature dependent resistivity measurement shows semiconducting behavior, which gets enhanced with increases in the annealing temperature. Measurement of nearly temperature independent carrier concentration (n) and vanishing thermopower indicates the spin gapless semiconducting (SGS) behavior in these films with hole as a dominating carrier. These classes of recently discovered materials exhibits finite energy band gaps for one spin channel and block the other spin channel. The fermi energies of 3.94 eV, 2.14 eV, and 1.28 eV corresponding to A-400, A-500, and A-600 evaluated from the thermopower measurement shows a decrease in fermi energy with the annealing temperature.

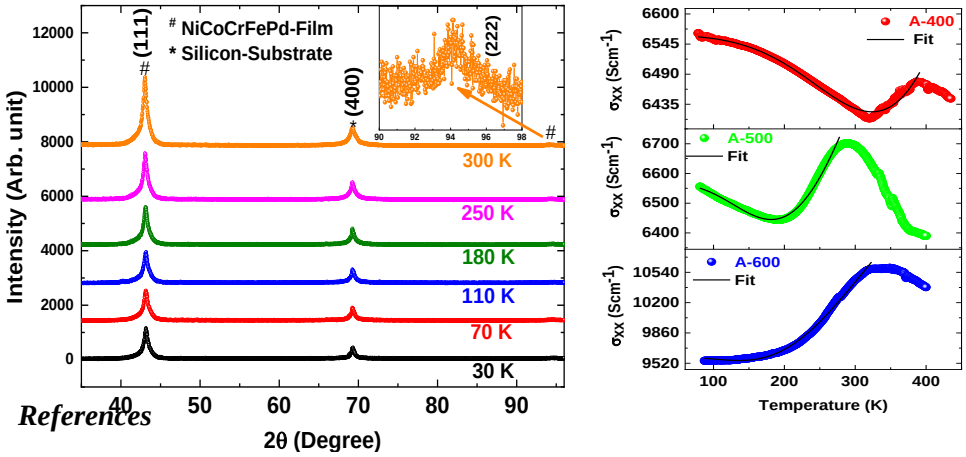

Fig. 1 (a) XRD pattern of A-400 sample annealed at 400 °C at different temperatures, **(b)** Longitudinal conductivity of samples A-400, A-500, and A-600 variation with temperature.

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Analyses of dielectric parameters of propanol-ethylene glycol binary system at microwave frequency

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Measurements of dielectric parameters (such as dielectric constant, dielectric loss and dielectric relaxation time) have been implemented using time domain reflectometry technique up to 50 GHz at different temperatures. The present paper deals with binary system of propanol-ethylene glycol mixtures over 11 different concentrations, at four different temperature and in the frequency range 10MHz to 30GHz. Molecular behaviour of given binary system have been studied using factors Kirkwood and Bruggeman.

Keywords*:* Time domain reflectometry, Dielectric relaxation time, Static dielectric constant, Binary mixture.

EFFECT OF CITRIC ACID ON THE STRUCTURAL, OPTICAL, MORPHOLOGICAL PROPERTIES OF ZnO AND THE BACTERICIDAL APPLICATION AGAINST HUMAN PATHOGENIC BACTERIA

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Zinc oxide (ZnO) nano-particles (NPs) were synthesized by microwave-assisted solution combustion method using citric acid as fuel and zinc nitrate hexahydrate as a precursor. The effect of citric acid concentration on structural, morphological and optical properties of ZnO NPs was studied. High resolution x-ray diffraction pattern exactly matching with the JCPDS card 01-089-1397 which shows the hexagonal (wurtzite) structure of ZnO with P63mc (186) space group [1]. The average crystallite size of ZnO NPs was 22.57 nm estimated using Scherrer equation [2]. The transition of crystalline Zn-O to amorphous have been seen as the concentration of citric acid changed due to formation of complex structure of zinc citrate. The presence of various functional groups in the synthesized material was identified by using Fourier transform infrared spectroscopy. The Zn-O metal-oxide band absorption peak was found in wavenumber less than 500 cm^{-1}. Scanning electron microscope image shows the agglomerated non-spherical particles. ZnO NPs showing the significant antibacterial activity against the growth of gram-negative micro-organism Escherichia coli [3].

Keywords: *ZnO; Citric acid; HR-XRD; Scherrer equation; E. coli.*

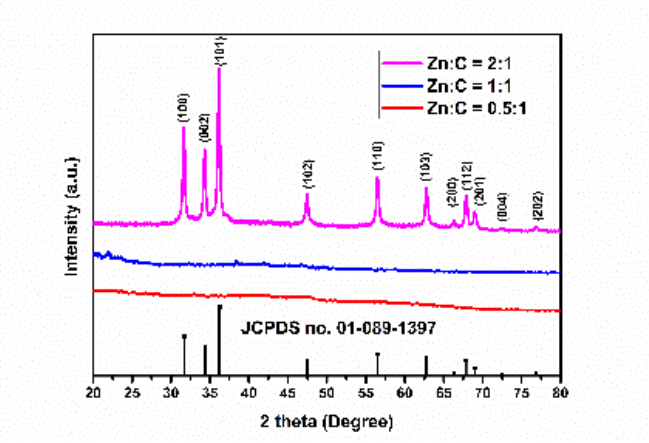

Figure 1. High resolution X-ray diffraction pattern of synthesized ZnO at different concentration of citric acid

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Chemisensors based on conducting Polypyrrole composites decorated with Titania nanoparticles towards potential application of CO_2 gas sensing

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Pure polypyrrole (PPy) and its nanocomposites decorated with titania nanoparticles were synthesized by in situ chemical oxidative polymerization using $FeCl_3$ as an oxidant.[1] Series of PPy-TiO_2 nanocomposites were obtained by varying the weight percentage of TiO_2 nanoparticles (5%, 10%, 15%, 20%, 25%, 30%) with the Pyrrole monomer.[2] Synthesized organic-inorganic hybrid composites have been characterized using XRD, FT-IR, UV-visible and TGA. XRD results demonstrates the amorphous nature of PPy while its composites with TiO_2 exhibit crystalline nature. The infrared spectroscopy reveals the presence of interaction between conducting PPy and TiO_2.[3] The varying composition of TiO_2 nanocomposite shows changes in their respective energy band gaps which were analysed by Tauc's plot using UV-visible spectra.[4,5] TGA data infers that the obtained nanomaterials have good thermal stability. Nanocomposites were screen printed on glass substrate to obtain gas sensors which were utilized as a potential application towards detection of CO_2 gas.

Keywords: Nanocomposites, Polypyrrole, TiO_2, CO_2 sensor.

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Synthesis of Imidazole metal complex by Green Approach for investigation of Their Antimicrobial and Anti-oxidant Activity

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The imidazole nitrogen containing heterocyclic ring which possess biological and pharmaceutical application [1-2]. These moieties are key components to functional molecules that are used in a variety of everyday applications [3]. The synthesis of substituted imidazole and their metal complex by green method. the synthesis imidazole and their metal complexes were characterised by spectroscopic technique viz. IR, NMR , U.V.-visible , XRD ,SEM Synthesized Ligand and metal complexes were evaluated by anti microbial and anti-oxidant activity by DPPH assay[4-5] . Key Word- Imidazole, Spectral analysis, Anti-oxidant activity and Antimicrobial activity.

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Fabrication, Molecular Docking and Antioxidant studies of 1,3,4-Thiadiazole Capped Metal Complexes

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Single pot heterocyclic [1] capping agent 5-(3-nitrophenyl)-1,3,4-thiadiazol-2-amine (NPTA) derived from nitro benzoic acid with thiosemicarbazide without using solvent by green approach. Its metal complex of Mn(II), Co(II) and Cu(II) has been fabricated by using the protocol of Sol-Gel. Synthesized compounds were characterized by using spectroscopic techniques X-RD, SEM, FT-IR, UV–vis spectra, antioxidant [2] and anti-microbial activity [3]. It was observed synthesized compounds showed positive results for both the biological activities [4]. Antioxidant activity carried out by DPPH assay. Result of this study indicated that substituted 1, 3, 4-thiadiazole moiety and their metal complex has optimistic source of antioxidant activity. Compounds showing the enormous pharmacological activity [5]. Furthermore, molecular docking assays have been performed to investigate the antioxidant and antibacterial properties

Key words: Metal Complex, Molecular Docking, Antioxidant Activity and Antibacterial Properties.

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Biological Activity of Phytochemicals Extracted from Medicinal Plants of Apocynaceae Family

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KEYWORDS: *Plant Medicine; Phytochemicals; Apocynaceae; Sustainable treatment*.

The current scenario of drug-resistant strains of bacteria, viruses, and other pathogens and the increasing prevalence of chronic diseases such as cancer, diabetes, cardiovascular diseases and the COVID-19 pandemic has created a need for more effective medicines for treatment. Existing synthetic drugs have adverse effects with complex and expensive synthesis processes. Therefore there is a need for new medicines from plants due to the limitations of existing drugs, emergence of new diseases, and fewer side effects associated with plant-based medicines. The *Apocynaceae* family is one of the most medicinally diverse families in the *Angiosperm* and is a rich source of medicines that have found use in both traditional and pharmaceutical medicines. The *Apocynaceae* family are rich in alkaloids, flavonoids, carbohydrate, terpenoids, lactones, steroids, and tannins. This review recognises the biological activity, extraction methods of phytochemicals or isolated phytochemicals used as a medicine to prevent different diseases in the future. The study concluded that some medicinally important extracted compounds include plumericin, isoplumericin, plumieride, ferulic acid, gallic acid, and geraniol. It also covers extraction processes like refluxing, maceration, soxhlet extraction, and microwave-assisted extraction with their suitability with extracted compounds and solvents. Plumeria species are reported to have antimicrobial, antioxidant, anti-inflammatory, and antimutagenic activities. Extracts from *Apocynaceae* can be used for the treatment of rheumatism, diabetes, cancer, and cardiovascular diseases. Extraction and use of these medical compounds are sustainable and cost-effective, leading to affordable and accessible treatments to mitigate the impact of future pandemics like COVID-19.

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Synthesis of Fe_2O_3/NiO nanostructure by solvothermal route for super capacitor application

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Keywords: Solvothermal method; Nanoflakes; BET surface Area; Electrode; Supercapacitor Power density.

A mixed solvent solvothermal approach was employed for the synthesis of Fe_2O_3/NiO nanostructures under a low temperature route. The nanoflakes when studied for its electrochemical performance in a 3-electrode method in aqueous 2 M KOH revealed a high capacitance value of 305.0 F g^{-1} at a scan rate of 5 mV s^{-1} apart from good rate capability, cyclic stability and coulombic efficiency. The fabricated symmetrical supercapacitor device also showed good electrochemical performance of pseudocapacitive nature with a high power density of 8000.0 W kg^{-1}. The extent of surface sites taking part in the electrochemical processes reveals the enhanced performance is due to the high surface area of NiO with a mesoporous structure. The enhanced conductivity of the nanoflakes also

provided an unhindered path way for the ionic transport. The promising results reveal that the synthetic technique employed could be extended to other oxides as well.

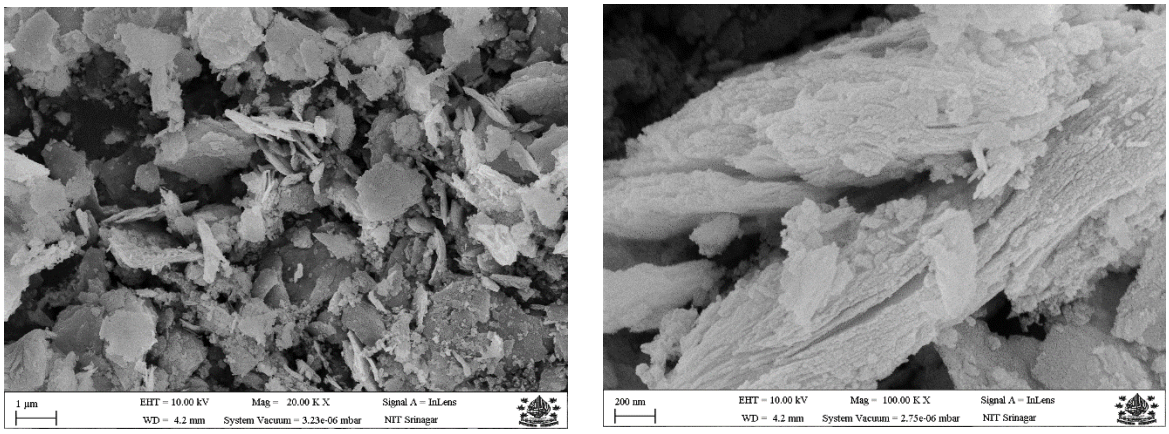

Fig. FESEM images of prepared sample

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Effect of UV irradiation on resistive memory device based on a biodegradable and biocompatible plant Ipomea Carnea:

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Implementation of biocompatible and biodegradable information storage would be one of the significant progresses towards the next generation green electronics. Natural plant materials based memory devices are not only the promising elements of environmental benign, biocompatible and biodegradable but also plays a great role towards the solution of huge e-waste. This work successfully employed the leaves of Ipomea Carnea (IC) in order to fabricate resistive memory devices. IC based resistive memory is found to have a double-set i.e. back to back schottky diode behavior effect, which is a typical behavior observed in natural plant material for the first time. Several parameters such as device yield 78%, having cyclibility upto 33, ON/OFF ratio of the order of 10^2, a good retention characteristic (>$7x10^4$) and good device stability (280days) has been analyzed. However upon UV irradiation, the resistive switching properties were greatly increases such as device yield upto 82%, read endurance (38cycles) and a high memory window of the order of 10^4. In order to visualize the conduction filament in the IC based resistive device, conducting atomic force microscope (CAFM) measurements has also been carried out .Also several investigations reveals that Gold filament and oxygen vacancy filament play an important role towards the conduction mechanism. Thus this work is

not only improves the mechanism of the resistive switching but also exhibits the practical application prospect for the future generation non-volatile memory device.

Keyword: Biocompatible, biodegradable, CAFM, Nonvolatile, resistive memory, oxygen vacancy.

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Rare-Earth (Dy^{3+} and Pr^{3+}) ratio variation effects on electrical properties of sodium fluoride alumino borate glass system

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Since less attention was paid to investigation of electrical properties of RE doped glasses, a glass series with composition $60B_2O_3$ + 30NaF + $10Al_2O_3$ + (1-x) Dy_2O_3 + (x/3)Pr_6O_{11} (where x = 0, 0.2, 0.5, 0.7 and 1 mol%) was prepared by melt quench technique and their Dielectric properties were studied and analyzed. It can be concluded from the ac conductivity analysis that all compositions follow Jonscher's Power Law. The Conductivity mechanism was investigated by calculating the frequency exponent "s" parameter at different temperatures and all the compositions satisfied the OLPT model. Dielectric properties: Dielectric Constant (ε'), Dielectric loss (ε'') and tangent loss (tanδ) were also investigated and observed that values of ε' and ε'' and tanδ decreased with increase in frequency and finally attain a constant minimum value at higher frequencies. The high rate of change in dielectric properties at low frequencies is attributed to space charge polarization while at higher frequencies it was decreased due to inertia of ions. Nyquist Plots for all compositions at 390°C were observed as semicircular arcs centered below the x-axis (Z') which evidenced the non-Debye relaxation behavior, and confirmed existence of constant phase element (CPE).

Terahertz time domain spectroscopy of magnetic nanoparticles and polymer matrix

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Terahertz time-domain spectroscopy (THz-TDS), is an effective method for characterizing materials and monitoring processes. Metals, electronics, 2D materials, and even superconductors have all been tested with this technique, which does not require physical touch to obtain accurate results. Terahertz (THz) spectroscopy has developed as a method for investigating dielectric and transient photoconductive characteristics of materials over the past few decades. Since it can measure electrical resistance without touching the sample and has a temporal precision of a few picoseconds. Due to the low energy of THz radiation and the narrow pulse width, THz-TDS technology is non-destructive when used for extracting visual data from materials (picosecond range). This paper reveals optical parameters extraction methods by using THz transmission spectroscopy technology. In summation, materials with a low absorption of terahertz radiation can benefit from the adaptability of transmission methods, while materials with a high absorption capacity can take advantage of the advantages of reflection methods. To measure the magnetic material's optical properties like refractive index and absorption coefficient, we employ a transmission-type terahertz time domain spectroscopic instrument. The observations and analysis are performed in both the time domain and frequency domain, and we examine the transmission of terahertz radiation through a polymer based magnetic nanoparticle substance at frequencies from 0.1 to 3 terahertz (THz). We provide novel insight into the ways in which crystalline magnetic nanoparticles incorporated into polymers (PDMS) can alter their electrical characteristics at THz frequencies. Significantly, we show that complex conductivity analysis is a highly effective, large, and non-destructive method. Here, a comprehensive assessment of THz time-domain spectroscopy's potential for use in characterizing polymer based magnetic nanopartilce is presented.

Keywords: Magnetic material, THz-TDS, Spectroscopy, PDMS polymer.

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Highly ordered 1D $NiCo_2O_4$ nanorods: An efficient hybrid material for electrochemical energy storage application

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Here, we presented the regularly arrayed nickel-cobalt oxide nanorods for use as a supercapacitor electrode. According to the findings of our research, the morphology of the nickel-cobalt oxides is

highly dependent on the reaction time as well as the ratio of Ni/Co. When $NiCo_2O_4$ are deposited on nickel foam, the fabricated electrodes show a specific capacitance of 950.6 Fg^{-1}, when scanned at 2 mVs^{-1} in an aqueous electrolyte containing 4 M KOH. After being put through a process that consisted of 4000 cycles, electrode maintained a capacitance of up to 85% of their initial capacitance. In addition to this the energy density and power density of 16.7 $Whkg^{-1}$, 233.2 Wkg^{-1} respectively at 7 $mAcm^{-2}$ current density. $NiCo_2O_4$ maintained an 85% cyclic charge/discharge stability and low resistance confirmed by electrochemical impedance spectroscopy.

Key words: Supercapacitor, nanorods, Energy density, $NiCo_2O_4$, Supercapacitor

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Composites based Hydroelectric Cell for Sustainable Electricity Generation by Water Molecule Dissociation

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Keywords: Multiferroics; Hydroelectric cell (HEC); Nanoporosity.

The planet is facing a serious environmental issue of pollution due to the energy produced from non-renewable resources, which themselves are at a stage to diminish. Innovation of Green energy Hydroelectric Cell has brought up a lot of advantages in this direction of cost-effective energy production. Dissociation of water molecules on the surface of oxygen deficient nanoporous metal oxides play a key role in the generation of current from the hydroelectric cell. Owing to the ability of multiferroic materials in various applications, lead-free composites of composition $x Na_{0.5}Bi_{0.5}TiO_3$-(1-x)$MnFe_2O_4$ [x=0.6,0.8] abbreviated as xNBT-(1-x)MFO have been synthesized by the conventional solid-state reaction method. Strain mediated defects formation is a unique feature of multiferroics which is focussed in a way to enhance nanoporosity and oxygen deficiency to increase the mechanism of water molecule dissociation. The maximum value of current and voltage generated for 0.6NBT-0.4MFO and 0.8NBT-0.2MFO HECs are 9.40mA, 1.009V and 4.12mA, 1.057V respectively. Higher value of current in case of 0.6NBT-0.4MFOcan be due to the presence of large no. of oxygen vacancies. This simple, eco-friendly and inexpensive technique opens up a new research area for the application of multiferroic composites.

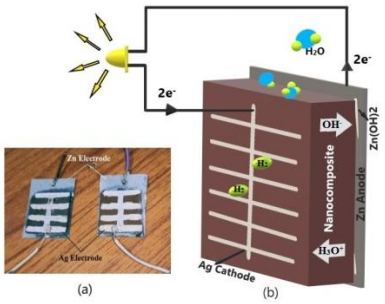

Fig. 1: Working mechanism of HEC

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APPLICATION OF MICROBE-AFFINITY THREE-DIMENSIONAL MICROPOROUS GRAPHENE FRAMEWORK FOR REMOVAL OF ORGANIC POLLUTANT

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KEYWORDS: Graphene-framework; bacteria; immobilization; water-remediation.

Severe impact on water contamination has caused great concern with the rapid rise of industrialisation and the global economy. It is challenging to ensure consistent availability of portable water. Bionanotechnology has piqued the interest of researchers due to its beneficial impacts, one of which being microbe-assisted nanotechnology for water remediation. Microbial immobilisation technologies have been widely used in wastewater remediation because to its high biological density, high toxicity resistance, and rapid startup process. Among carbon-based nanomaterials, three-dimensional (3D) graphene oxide-based derivatives have showed great properties, such as promoting cell colonisation and supporting substrate transport. Graphene oxide networks also have a high surface area, mechanical strength, and functional moieties on their surface, such as hydroxyl, carboxyl, carbonyl, and epoxy groups, allowing them to interact with microbial cells and different polymers. Polyurethane (PU) has various advantages, including ease of handling, strong regeneration ability, and, most importantly, a relatively low cost. The incorporation of PU increases the surface area for microbial habitats while decreasing microbe residence time. Microbe adsorption on porous PU-GO foam

carriers can result in a high density of immobilised microorganisms as well as good mass transfer capabilities. We investigated the biocompatibility of PU-OGF foam at various concentrations in this work. This immobilised system has the potential for biotechnological applications such as oil remediation from waterways.

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Impact of Barium oxide on alkali containing Phosphoborate Bioactive Glasses

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Keywords: Bioactive glass, In vitro bioactivity, SBF, XRD, FTIR.

Multicomponent glass system with composition xBaO–$2K_2O$–$2P_2O_5$–$27Na_2O$– 21CaO– (48-x) B_2O_3 (x = 0, 2, 4, 6 & 8 mol% abbreviated as BA0-8, respectively) were synthesis via melt quench process [1]. Density and molar volume measurements were carried out to analysis the physical properties of as prepared samples. *In vitro* bioactivity of synthesized samples was evaluated by immersing the samples in simulated body fluid (SBF) at 37 °C for 7, 14 and 21 days [2]. X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) were conducted to identify the change in samples before and after treated with SBF. XRD and FTIR confirm the amorphous nature of as prepared samples. It was found that addition of barium oxide may delay in hydroxyapatite (HAp) formation. The *in vitro* bioactivity of studied samples makes them possible candidate for tissue engineering application.

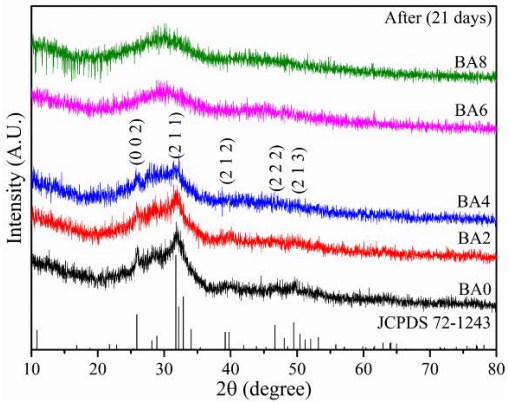

Fig. 1. XRD pattern of BA0-8 samples after SBF treatment for 21 days.

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INVESTIGATING THE ROLE OF GOLD NANO PARTICLE (AUNP) MEDIATED ALTERATION IN CELL GROWTH IN BACTERIA TO IN VITRO CELL-LINE MODEL SYSTEMS.

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Keywords: Gold nanoparticles, mutants, proteomics, Aminoglycosides.

Nanoparticles based therapeutics (Nanotherapeutics) has been termed as game changer in medical science due to wider applications like, biosensing, bioimaging and drug delivery and minimal toxicity. Despite such wider therapeutic applications, our understanding about AuNPs interaction with various biological models and their effect on cellular and metabolic processes remain poorly understood. In this study, we synthesized and characterized interaction of citrate capped AuNPs of different sizes (5nm and 10nm) with Bacteria and yeast. We demonstrated that exposure to high-dosages of citrate-stabilized, spherical AuNPs (<10 nm diameter) accelerated the growth rate of bacteria and yeast.To determine underlying mechanism of compatibility and toxicity associated with AuNPs, a systematic screening of various stress mutant strains namely recA and recN (DNA damage mutants), ΔraeS, ΔrcsF, ΔpcpC, ΔcpxA, ΔbaeS (deficient in inducing envelope stress) and ΔrpoS (deficient in inducing general stress response) was carried out. Our data revealed no role of these well-known stress responses A careful investigation revealed that *E. coli* cell-cycle was expedited in presence of AuNPs, resulted in reduced cell-division time and higher cell-density during stationary phase. To address whether alteration in cell-cycle is exclusive to gram negative bacteria (*E. coli*) or is a conserved phenomenon, we found similar observation with other well-known model organisms namely *Bacillus subtilis* (gram-positive), *Saccharomyces cerevisiae* (yeast, single-celled fungus microorganisms). Further, we screened effect AuNP on two cell lines namely A549 (lung cell-lines) and HaCaT (human epidermal keratinocyte) and found a dose dependent toxicity (MTT assay) but also found cell-proliferation at lower concentration (in both sizes). These observations across organisms, implies a conserved molecular mechanism underlying the cell proliferation upon treatment with AuNP. Differential proteome analysis in both *E. coli* and *S. cerevisiae* revealed under-expression of the majority of ribosomal proteins, except for a few, upon exposure to high doses of AuNPs. Interestingly, homologs of over-expressed ribosomal proteins are reported to be increased in cells proliferating under stress conditions. Exclusive sensitivity to sub-lethal doses of Aminoglycosides and Rapamycin confirmed alterations in the cellular translation rate. We propose that exposure to high doses of AuNPs creates stress on the cellular translational machinery to promote protein synthesis *via* the non-canonical mode.

A review of various delignification methods of wood

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Keywords: Membrane separation, Polymeric membranes, Wood waste, Delignification, Porosity.

The energy needed for membrane separation is lesser than the energy required for separation processes such as distillation and crystallization. The most common membranes are polymeric membranes, which are deteriorated after usage and thus discarded and must be replaced regularly. The disposal of these conventional membranes poses a great threat to the environment. The alternative way can be selecting naturally existing polymers as raw materials and converting them into membranes. One of the materials identified is wood waste which has cellulose, the major chemical component of fiber wall. The hydroxyl groups on these linear cellulose chains have a strong propensity to form inter and intramolecular hydrogen bonds, which stiffen the straight chain and encourage aggregation into a crystalline structure, giving cellulose a variety of partially crystalline fiber structures and morphologies. Membranes prepared from wood must be free of lignin and hemicellulose which resist the ability of wood to be porous. Various methods and techniques are used to remove these components. This review paper focuses on various methods to remove lignin and hemicellulose using different chemical treatments. Some of the methods discussed, mainly focus on dissolving extractives, removing hemicellulose and more particularly lignin using various organic solvents and inorganic solutions at elevated temperatures. Since lignin is present inside the intercellular spaces, its removal would increase the porosity of the wooden membranes. But the complete delignification of the samples leads to the collapse of cellular structure and hence an optimum degree of delignification must be achieved. All the methods have been able to remove significant amounts of lignin and hemicellulose from wood.

Exploring the potential of organic insulating materials in remote areas of Kashmir valley for sustainable building construction

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Keywords: Environment, Energy, Organic insulations, Remote areas.

Energy and the environment are becoming more precious every day, and with it comes the need to preserve them. Buildings are responsible for approximately 40% energy consumption in USA and almost one third around the world [1], and thermal insulation is an effective way to control the energy needs in a building. However, environmental sustainability is an important factor to consider while deciding the type of insulation in a building. Although many insulating solutions have been studied so for but there have been few attempts to find their relevance in remote areas. Among all the insulating materials, organic materials have the least environmental impact. Organic insulating materials are made from renewable natural resources like cotton, wool, straw, hemp, etc, and are more environmentally sustainable. The use of such insulation materials in remote areas for the insulation of buildings can reduce the environmental impact, and enhance the energy efficiency of buildings in these locations. The organic insulations may be inferior to the other high-quality inorganic insulations,

but their use in remote areas needs to be studied from the perspective of life cycle assessment. An increase in transportation costs, installation costs, and the respective energy usage of inorganic materials in remote areas are some of the aspects to be understood. The disposal of these materials in remote areas poses a greater threat as well. In this paper, we review the scope of organic materials which are available locally in remote areas of Kashmir as effective thermal insulating solutions and means to ensure environmental sustainability.

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Impact of chitosan based essential oil nanoparticles on the quality and acceptability of meat emulsion under aerobic refrigerated storage

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Keywords: Nanoencapsulation, Antioxidants, Meat emulsion, Oregano essential oil, Thyme essential oil.

Meat and meat products are excellent sources of high-quality proteins, essential amino acids, B-vitamins, minerals and various other micronutrients offering a number of health benefits. Emulsion-based meat products (O/W emulsion) are one of the most important and significant categories of these meat products, adding variety to our food basket in the form of meat balls, sausages, loaves, patties, nuggets, and so on. Although meat emulsion formation aids in the profitable utilization of tough meat, reduction of product costs and improvement of yield and quality of the finished products, but the process of size reduction is often responsible for oxidative degradation of the meat products, limiting their shelf life and producing certain unhealthy chemical metabolites. Thus, it would be in the best interests of society and the global meat industry if raw emulsion could be preserved as such and marketed as a ready-to-cook (RTC) convenience meat product, suitably packaged in appropriate packages with cooking instructions. Owing to various toxicological and environmental concerns associated with the use of synthetic preservatives and additives, the food industry has shifted its focus to the use of natural preservatives like plant extracts and essential oils. Nano-encapsulation, the bioactive packing of materials (including essential oils) at the nano-scale range, provides an efficient alternative to traditional use of these essential oils by limiting their interactions with food matrix. The encapsulating wall protects the core substance (essential oils) from thermal and chemical degradation and increases its stability in the corresponding environment. It also reduces the volatility of essential oils, masking their unpleasant odours and flavours. Keeping in view the aforementioned facts, a study was conducted to investigate the impact of chitosan-based Oregano and Thyme essential oil nanoparticles at 0.05% level (standardized in earlier experiments) on the quality and storage stability of mutton emulsion under aerobic refrigerated storage. These oils enjoy a GRAS (Generally Recognized as Safe) status making them suitable candidates for meat preservation. The results showed that the essential oil nanoparticles had no negative sensory effect on the meat emulsion with treated emulsions having significantly better scores than control emulsion during the end part of storage. TBARS value, Peroxide value, Tyrosine value, DDPH, and Reducing Power of treated emulsions was significantly desirable than the control emulsion at the end of storage. The treatments also restricted the Total Plate Count, Coliform Count and Yeast and Mould count of the emulsion with in the acceptable limits. Thus, it was concluded that these essential oil nanoparticles could be used to

maintain the quality characteristics of the meat emulsion during aerobic refrigerated storage, thereby increasing its overall shelf life.

Polyethylene glycol-assisted hydrothermal synthesis of hydroxyapatite nanorods for bone tissue engineering

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Keywords: HA nanorods, Hydrothermal, Biocompatible.

Owing to resemblance of hydroxyapatite (HA) nanorods with mineral component of living bone tissue, it attracted appreciable attention as excellent bone material. [1, 2] In this study, rod-shaped HA nanocrystals has been synthesized in presence of polyethylene glycol (PEG) 400 under hydrothermal condition. X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) are used to characterize the composition and morphology of developed HA nanocrystals. Results confirm the formation of HA nanocrystal with rod like morphology. *In vitro* bioactivity of developed HA nanorods has been examined after incubation of HA nanorods pellet in stimulated body fluid at 37ºC. A bone like apatite layer has been formed on the surface of HA pellet after 7 days which shows good *in vitro* bioactivity of HA nanorods. Moreover, MTT result also revealed that HA nanorods demonstrates higher cell viability as compared traditional HA which make the HA nanorods a good biocompatible. These studies clearly show that HA nanorods can be a potential material for bone tissue engineering application.

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Electrical and Thermal Behaviour of Transition Metal Containing Multi Component Oxide glasses

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Keywords: Dielectric constant, ac conductivity, glass transition temperature, crystallization temperature.

Barium-boro-bismuthate glass system having composition $x$$TiO_2$-(10-$x$)$V_2O_5$-25BaO-20$B_2O_3-45Bi_2O_3$ (where x= 0.0, 1.0, 3.0, 5.0, 8.0, 9.0 and 10.0 mol%) were prepared through melt-quench technique and abbreviated as TVBBB(x=0, 1, 3, 5, 8, 9 & 10). These glass systems were investigated under their

electrical and thermal behaviour via Impedance spectroscopy and Differential Thermal Analysis (DTA). The temperature and frequency dependence of various dielectric parameters (such as dielectric constant, dielectric loss and ac conductivity) for synthesized samples were being analyzed. The study of dielectric behaviour and ac conductivity, reflects their usability in field of energy storage, semiconducting and opto-electronic applications. The ac conductivity of prepared samples was identified at 400°C and found around 10^{-5} (Sm^{-1}) showing high temperature semiconducting nature. The DTA curve shows the thermal stability of prepared samples and helps to identify various characteristic temperatures such as glass transition (T_g), onset crystallization and crystallization (T_x & T_c) temperatures. As per DTA curve the glass transition and crystallization temperatures were identified near about 410°C and 500°C respectively. The exothermic peak in DTA curve reflects high nucleation ability of prepared samples.

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Self-assembly of miktoarm star polymeric fluid in different solvents

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Keywords: DPD Simulation; Self-assembly; miktoarm star polymer; segregation; morphology.

We present the self-assembly of miktoarm star polymer (MSP) in different solvents using the dissipative particle dynamics (DPD) simulation method in 3[1,2]. One MSP molecule is considered to have six arms with an alternate arrangement of equal incompatible arms. Each arm contains 8 DPD beads, linearly connected as a bead-spring model. All the arms are covalently attached to a single core bead. An initial homogeneously mixed polymeric solution prepared at a high temperature is quenched to a lower temperature. The system becomes thermodynamically unstable and begins to segregate into its components. The evolution morphology patterns are characterized by the radial distribution function, twopoint correlation function, structure factor, and domain growth function, which are significantly different in different solvents. We observe that the scaling correlation functions do not overlap and deviate from the universality class. Typically, domain size follows the power law :(t) ~t ϕ with dynamic growth exponent [3].

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DESIGN AND OPTIMIZATION OF AMPHOTERICIN-B POLYMERIC NANOPARTICLES LADEN IN-SITU GEL FOR OCULAR FUNGAL INFECTIONS

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Keywords: Ocular fungal infection; Polymeric nanoparticles; Amphotericin B; In-situ gel; Gellan gum.

Ocular fungal infections are rare but quite serious, as they affect different regions of the eye, namely cornea (keratitis), or vitreous and/or aqueous humor (endophthalmitis) (Kalkanci and Ozdek, 2011). Topical amphotericin B is considered the drug of choice for its treatment (Thomas, 2003). It was further observed that due to the presence of various protective ocular barriers, the dosage forms are not readily bioavailable in the inner region of the eye. Also, less amount of ocular dosage form reaches the target site due to nasolacrimal drainage, pre-corneal elimination of drug and frequent eye blinking (Gaudana et al., 2010, Agrahari et al., 2016). So, to overcome the drawbacks, we designed and optimized amphotericin B-loaded polymeric nanoparticles (AB-PNPs) which were further incorporated into in-situ gel (AB-PNPs-ISG), for facilitating sustained release. The optimised NPs showed an average particle size of ~ <100nm, ~0.25 PDI, 92% EE, 4.37% DL with significant sustained release for 10 hr. additionally, the AB-PNPs were incorporated in gellan gum solution and rheological properties were analysed concerning time and temperature. The optimized AB-PNPISG showed improved anti-fungal activity, in comparison to free AB, and blank PNPs, as assessed by in vitro antifungal efficacy studies, and was comparable with the commercial product.

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INSIGHT INTO THE SYNERGISTIC EFFECT OF ADSORPTION–PHOTOCATALYSIS FOR THE REMOVAL OF ACID BLUE 113 DYE POLLUTANTS BY Cu- BASED METAL ORGANIC FRAMEWORK

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KEYWORDS: Metal-organic framework; Nano porous catalyst; Acid Blue 113, White LED light, Photocatalytic dye degradation.

It is toxic, stable, and challenging to degrade Acid Blue 113 dye, which is widely used in the textile industry to dye fabrics [1]. Photocatalysis is one of the most promising methods for the removal of industrial pollutant containing dyes. Herein, a metal-organic framework (MOF-199) as a Nano porous material was synthesized by a modified solvo-thermal method and characterized using FESEM, EDS, FTIR, XRD, BET, and TGA [2]. The effect of catalyst dose, initial pollutant concentration, and visible light irradiation was studied. The sample was added to an aqueous solution of acid blue 113 dye (50 mg/L and 100 mg/L) and stirred in complete darkness for 30 min to create an equilibrium of adsorption-desorption. Visible light (9 Watt, 20 Watt, and 50 Watt LED) were irradiated the reaction mixture at different intervals. The maximum removal of AB113 (50 mg/L) on MOF-199 during the photocatalysis cycle was 96.5% in 120 min, under 20 watt LED light. These results indicated that the MOF-199 hybrid photocatalyst possesses superior photocatalytic capacity under 20 W LED irradiation.

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AI ASSISTED DESIGN AND FABRICATION OF CHEMICAL SENSOR ARRAY FOR VOCs DETECTION

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KEYWORDS: Chemical Sensors; Semiconductor Metal Oxides; Machine Learning; Volatile Organic Compounds.

Semiconducting Metal Oxides (SMO) are the most common materials used in gas sensor technology. It works on the variation of surface electrical conductance in a gaseous environment. Medium to wide-bandgap oxide semiconductors is an excellent choice for gas sensing material due to intrinsic donors/acceptors in the bandgap. It has been demonstrated that high-power consumption can be reduced by designing nanostructure-based chemical sensors with ultra-small device footprints to achieve room-temperature operations. By designing a sensor array, this study investigates the low selectivity of SMO by using multivariate data analysis tools. Here the pattern of each gas-sensitive oxide layer is recorded and analyzed using a statistical analysis method, for example, Principal Component Analysis (PCA) and Artificial Neural Network (ANN) algorithms. The extensive data set shall be screened using Machine learning methods to evaluate the best oxide candidates and their simultaneous sensor characterization undertaken upon fabrication. The outcomes are processed using traditional PCA algorithms integrated with machine learning techniques[2] (including NN) to select desired gas per the end-use application. This can help to detect gases like volatile organic compounds[1] (ethanol, acetone, etc.), humidity, ammonia, NO_x, etc. Therefore, the same sensor array could be used to detect various gases for applications like monitoring body vitals, detecting air pollutants, defence-related applications, etc.

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WS_2 QUANTUM DOTS AS AN EFFECTIVE FLUORESCENT SENSOR FOR MONITORING OF OFLOXACIN ANTIBIOTICS IN WATER

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KEYWORDS: Antibiotics; Quantum dots (QDs); Fluorescent Sensor; Ofloxacin.

Biological and chemical hazards (antibiotics, pesticides, etc.) present in water and food are the major threats to the environment and human health. Therefore detection and degradation of these hazards are important for a solution of environment pollution and human health. Herein, we report a simple and ecofriendly approach to synthesize WS_2 quantum dots (WS_2QDs) using $Na_2WO_4.2H_2O$ as precursor material for monitoring of Ofloxacin (Oflx) antibiotics in water by adopting fluorescent optical detection technique. The as prepared monodispersed WS_2 QDs possessed excellent photostability and good solubility in water along with a good shelf life. The WS_2QDs were able to detect ofloxacin antibiotic with satisfactory result of selectivity and sensitivity over other antibiotics. The PL emission of WS_2QDs interacting with Oflx was quenched linearly by varying concentration from 5 to 300μM. The detection limit (LOD) was noticed to be very low as 0.4μM referring to WS_2QDs as a potential fluorescent sensor for Oflx detection in water. Above all, we observed decent results on treatment of WS_2QDs for the determination of Ofloxacin antibiotic in real samples. This indicates that such an approach can be promising for future use in real time application.

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MnBi/Fe_3C@C nanocomposite hard magnets by high energy milling

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KEYWORDS: Permanent magnets; MnBi; exchange-spring magnets; Ball milling, Nanocomposites; TEM.

Permanent magnets made of rare earth (RE) metals are a crucial component of electromechanical conversion systems, including actuators, hard disc drives, turbine generators, loudspeakers, and actuators. The researchers were forced to look for alternatives to these RE based permanent magnets in 2011 due to a rare earth metals issue. MnBi in the low temperature phase (LTP) has drawn a lot of attention as a potential "Gap Magnet" between ferrites and rare-earth magnets (energy product between 10 and 30 MGOe). Even though the first-principles calculations predict that the LTP MnBi magnet will have a high theoretical energy product $(BH)_{max}$ of 17.7 MGOe, only 7.8 MGOe has been attained at room temperature in sintered bulk magnet up to this point. In this study, we present the exchange-spring nanocomposite magnets of MnBi (hard phase) and Fe_3C@C (soft phase) powders with enhanced magnetic properties [1]**.**

Initially, Fe_3C@C nano-powders with high saturation magnetization (M_s) (~150 emu/g) were prepared using hydrothermal route followed by calcination. TEM analysis revealed a uniform 10 nm coating of carbon above Fe_3C. The $Mn_{55}Bi_{45}$ alloy was obtained by vacuum-arc melting stoichiometric amounts of raw material. Fe_3C@C nano-powders were added in varying proportions (5, 10, 15 and 20 wt. %) to $Mn_{55}Bi_{45}$ alloy powders during cryo-milling. Cryo-milling of 2 hours results in reduced particle size of the nanocomposite which in-turn enhances its coercivity (up to 6.3 kOe for10 wt. % sample). The addition of Fe_3C@C results in improvement of the overall saturation magnetization with the 10 wt. % sample achieving upto 53 emu/g. Cryo-milling also facilitated in reducing the particle size in shorter durations with considerably less oxidation and LTP decomposition than the room temperature ball milling. The carbon coating on Fe_3C not only protects the soft phase from oxidation degradation but also causes an increased M_s value as carbon coating on MnBi grain occurs during milling process. Overall, enhanced energy product of around 2 MGOe could be achieved without field aligning the nano-particles, which is a considerable value. This work paves the way for Fe_3C@C nanoparticles to be used as soft phase for preparing exchange-spring magnets. Further, the improvement in energy product of the MnBi system makes it possible towards its commercialisation.

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Tuning the Electronic Properties of 2D Stanene by Strain

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KEYWORDS: Two-dimensional; Van der Waals; density functional theory.

Two-dimensional (2D) layered materials have sparked a great deal of interest in both basic physics and applied sciences in recent years. They are different from bulk materials because of the removal of Van der Waals (VdW) interaction and increase in surface area-to-volume ratio. Several other 2D materials have been reported like hexagonal boron nitride (h-BN), metal dichalcogenides (MX_2), silicene, germanene, borophene, stanene, plumbene, phosphorene etc. They have attracted a lot of attention due to their significant properties and widespread uses in electronics, optoelectronics, catalyst, energy storage facilities, solar cells, lithium batteries, etc. [1,2]. Interest in strain engineering of 2D materials has recently experienced a spike in attention, driven by the expanding requirements of creating semiconductor devices at ever-decreasing sizes. As strain immediately impacts the lattice structures and subsequently modifies the electronic structures, it is regarded as a straightforward yet effective technique to change the characteristics of 2D materials [3]. The idea behind this technique is to use strain, to fine-tune the electronic and optical performance of 2D stanene. A comprehensive understanding of the nature of this material may be gained by continuous, high-throughput research using modelling techniques like density functional theory (DFT) to further explore the possibility of various applications in different fields.

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AB INITIO STUDY OF MECHANICAL PARAMETERS AND MAGNETIC PROPERTIES OF FeTiVNi AND FeCoVNi HIGH ENTROPY ALLOYS

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KEYWORDS: High Entropy Alloys; Magnetic properties; Mechanical stability; DFT.

High-Entropy Alloys (HEAs), often exist as simple solid solutions with crystal structures that are either hexagonal closed-packed (HCP), face-centered cubic (FCC), body-centered cubic (BCC), or a mixture of these three. These alloys are comprised of number of elements with equiatomic or nearly equiatomic concentrations and have distinct properties [1]. The mechanical and local magnetic properties of FeTiVNi (BCC) and FeCoVNi (FCC) HEAs were investigated by computational methods which reveal that FeTiVNi and FeCoVNi are mechanically stable. Density Functional Theory (DFT) was employed to compute the thermodynamic stability, elastic and local magnetic properties of these HEAs. Using the stress-strain method and Voigt-Reuss-Hill approximation, the elastic constants and modulus were determined. The values of bulk modulus for FeTiVNi and FeCoVNi are 171.34 and 253.23 GPa respectively, which are more than the bulk modulus of some commonly used steels. All the alloys had distinct mechanical anisotropy and values of B/G (Pugh's ratio) $\geq$ 1.75 and Poisson Ratio (ν) $\geq$ 0.29 show the materials are ductile in nature. The values of local magnetic moment, spin-polarized DOS, and elemental pDOS have been calculated and plotted. The value of magnetic moment for FeTiVNi is 0.189 μB and FeCoVNi is 0.586 μB, respectively which is in accordance with the reported value [2].

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Zinc oxide/Gum acacia nanocomposite alleviate zinc deficiency in soil and support *Spinacia oleracea* L.

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Keywords: Slow-release fertilizer, Zinc oxide, Gum acacia, Sustainable agriculture, Spinacea oleracea, green synthesis.

Greener techniques of nanofertilizer synthesis have received a lot of interest in recent years among diverse sustainable agriculture practices. The current study shows the green synthesis of ZnO nanoparticles utilizing *Melia azedarach* L. leaf extract and its combination with gum acacia to develop a nanocomposite (ZnOGA). XRD, FTIR, FESEM, and EDX were used to investigate the structural and morphological properties of ZnOGA. A pot experiment study was conducted with *Spinacia oleracea* L. to assess the efficacy of synthesized ZnOGA as a slow-release fertilizer and was

compared to a commercial fertilizer, zinc sulphate monohydrate. Commercial zinc fertilizer at 10 mg/kg and ZnOGA at 3, 5, and 10 mg/kg were used in the treatment. The variance analysis results revealed that each treatment had a significant effect on zinc release as well as plant development. According to soil column experiments, ZnOGA reduces zinc leaching by 52% when compared to commercial zinc fertilizer. When compared to commercial zinc fertilizer, plant growth metrics such as root-shoot length, plant height, fresh and dry biomass, photosynthetic pigments, and carotenoids increased significantly ($p<0.05$) in plants fed with ZnOGA. Furthermore, ZnOGA-fertilized plants had significantly greater protein content, free radical scavenging activity, phenolic content, total soluble sugar, proline, and Zn absorption. The amount of fertilizer used has been found to have a significant impact on plant growth and productivity. This study indicated that ZnOGA might be used as a sustainable agriculture alternative to commercial zinc fertilizer.

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A review on various hydrogen production methods

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Keywords: Non-renewable fuels, Hydrogen, Water splitting, Thermo-electrolysis.

Today's world necessarily requires more energy than ever before. Traditional fuels such as coal and oil are both non-renewable and contribute to a variety of environmental issues [1-3]. The major issue is the emission of greenhouse gases (GHG) which contributes to global warming [1,3]. As a result, it is critical to develop an alternative fuel source that not only is renewable but is also capable of meeting rising energy demands while also addressing CO_2 emissions and the overall environmental impact. One potential solution is hydrogen, which can provide sustainable, efficient, and cost-effective energy on a large scale while producing only water as a by-product [1,3]. Along with the energy the only by-product it produces is H_2O. Currently, natural gas (methane) provides more than half of the world's industrial hydrogen. However, it emits approximately 10 tonnes of CO_2 for every tonne of hydrogen produced; necessitating the need for a more sustainable method [3]. This review paper focuses on discussing the limitations associated with various mechanisms like water splitting (electrolysis & thermo-electrolysis), biomass gasification, and natural gas (NG) reforming with carbon capture and storage (CCP) to produce hydrogen.

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EFFECT OF CRUMB RUBBER-NANOSILICA COMPOSITE ON SOFT GRADE ASPHALT RHEOLOGICAL PROPERTIES

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Keywords: Crumb rubber; Nanosilica; Superpave rutting parameter; Superpave fatigue parameter; Storage stability.

Nanomaterials have been widely used to enhance the physical, rheological and mechanical properties of asphalt binders in recent years. Addition of nano-sized additives improves the performance of asphalt binder and overcomes the drawbacks of polymers. Thus, polymer nanocomposites are considered to be more powerful modifiers. Nanosilica is an inorganic nanomaterial that has been being widely used to enhance the performance of polymer modified asphalt. Addition of Nanosilica improves the storage modulus, elasticity and ageing resistance of asphalt binder because of its high specific surface area, high functional density and high strain resistance. This study aims at investigating the effect of using nanosilica (NS) as a modifier for Crumb rubber (CR) modified asphalt binder. In this study, the concentration of CR was kept constant as 12% (wt of base binder) and the nanosilica concentration was varied from 1%-6% (wt of base binder). The effect of varying concentrations of nanosilica on CR modified binder were evaluated by utilizing various physical tests, rotational viscosity (RV), dynamic shear rheometer (DSR), thin film oven (TFO), pressure aging vessel (PAV) and storage stability test. Results showed that crumb rubber-nanosilica modified bitumen exhibited higher complex modulus (G*) and lower phase angle (δ), indicating an improvement in the stiffness and elasticity. The addition of nanosilica also showed enhancement in rutting performance, Brookfield viscosity and storage stability of CR modified binders.

EFFECT OF SBS-NANOSILICA COMPOSITE ON BITUMEN RHEOLOGICAL PROPERTIES

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Keywords: Styrene Butadiene Styrene; Nanosilica; Superpave rutting parameter; Superpave fatigue parameter; Storage Stability.

To improve the performance of asphalt mixture, it needs to be modified with suitable modifiers. Nowadays, pavement technologist and researchers have put their interests in nanotechnology because of their extraordinarily interesting properties. A defining feature of polymer nanocomposites is that the small size of fillers leads to a dramatic increase in interfacial area as compared to traditional composites. Nanosilica is generally used in the preparation of polymeric nanocomposite blends due to the high reaction between silica material and the asphalt binder that results in higher dispersion ability of nanosilica and polymers within the bitumen blend compared to other nanomaterials. In this paper, the effect of using nano silica as a modifier for SBS modified asphalt binder was studied. The effect of varying concentrations (1%, 1.5%, 2%, 2.5% and 3%) of nano silica on 3% SBS modified binder were evaluated by utilizing various physical tests, rotational viscosity (RV), dynamic Shear Rheometer (DSR), thin film oven (TFO), pressure aging vessel (PAV) and storage stability test. Result showed that Nanosilica-SBS modified bitumen exhibited higher complex modulus (G*) and lower phase angle (δ), indicating an improvement in the stiffness and elasticity. Addition of nano silica also showed enhancement in rutting performance, Brookfield viscosity and storage stability of SBS modified binders.

Synthesis of CuO nanoparticles using maize silk extract, characterization and evaluation of its antibacterial activities

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KEYWORDS: XRD, Monoclinic, NPs, Morphology, Well diffusion, ZOI.

CuO nanoparticles are now a day used to target bacteria as an alternative to antibiotics. CuO nanoparticles were synthesized by sol gel method. The synthesized nanoparticles were characterized by x-ray diffraction (XRD), Fourier transform Infrared (FT-IR) spectroscopy, Scanning electron microscope (SEM) and antimicrobial activities. The XRD verifies that this sample is in wurtzite phase with hexagonal crystal structure. The average crystallite size of CuO nanoparticles is calculated using Scherer equation and is about 40 nm and is well matched with JCPDS card (No. 37-1493). Powder X software was used to determine the lattice parameters. FT-IR shows various characteristics functional group present in the prepared CuO nanoparticles. Further FT-IR confirmed the presence of bioactive functional groups involved in the reduction of copper sulphate to copper oxide nanoparticles. The spectral peaks at 400-600 cm^{-1} proposed the formation of CuO nanoparticles. The morphology of CuO nanoparticles was analyzed by scanning electron microscope. The structure of CuO nanoparticles was found spherical in shape. Plants silk extract mediated CuO nanoparticles showed strong antibacterial activities against both gram positive and gram negative bacteria. Well diffusion method was used to check antibacterial activities against gram positive (Staphylococcus aureus) and gram negative bacteria (Escherichia coli, and Klebsiella pneumonia) under different conditions.

Performance of Crumb Rubber-Nanoalumina Modified Asphalt Binder at High and Moderate Temperatures

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This study's objective is to determine the effects of incorporating nanoalumina (NA) into an asphalt binder that has been changed using crumb rubber (CR). In this study, the amount of nanoalumina was varied from 1% to 6% while the amount of CR was maintained at 12% (weight of base binder) (decided after literature survey). In order to evaluate the effects of various nano alumina concentrations (by weight of binder) at varied concentrations (1%, 2%, 3%, 4%, 5%, and 6%), physical tests such as penetration, softening point, and ductility were used. Using the Rotational Viscosity (RV) and Dynamic Shear Rheometer (DSR) tests, theological characteristics of the base binder and the nano alumina polymer modified asphalt binder were analysed. Also, the effectiveness of modified asphalt following tests in a thin film oven (TFO) for short-term ageing and a pressure ageing vessel (PAV) for long-term ageing was evaluated. The storage stability of the modified asphalt binder was also assessed. The results demonstrated that adding nano alumina improved the anti-rutting properties of CR modified asphalt binders. After the addition of nano alumina, the storage stability of the CR modified asphalt binders dramatically increased. The addition of 4% NA and 12% CR enhances the performance of the binder's rutting strength, according to the Superpave rutting metric (G/ Sin). The fatigue measure also showed a minor rise at a particular proportion of CR and NA.Improvements to the asphalt binder show no phase separation under high temperatures, according to a storage stability test. This suggests that the CR-modified binder's physical properties were successfully improved when a little amount of NA was introduced. As the amount of nano alumina was increased, it was discovered by rheological characterization that the complex modulus, phase angle, Superpave Rutting parameter, and failure temperature all increased. Furthermore, it was discovered that as the binder stiffens, Brookfield viscosity rises with the concentration of nano alumina. All test findings supported the assertion that the crumb rubber-Nanoalumina modifier is efficient in enhancing the high temperature qualities (rutting resistance) of the soft grade binders while also increasing the elasticity.

Keywords: Crumb Rubber, Nanoalumina, Superpave Rutting Parameter, Superpave Fatigue Parameter, Viscosity, Ageing, Storage Stability

Origin of dopant's valence state dependent H_2 evolution rate in $BaTiO_3$ photocatalyst

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Keywords: $BaTiO_3$, doping, visible light absorption, green H_2 generation, water-splitting reaction.

Rational design of photocatalysts for enhancing solar H_2 generation via water-splitting is critical to reduce the cost of green H_2 [1,2]. To this end, barium titanate ($BaTiO_3$) is a promising photocatalyst with a range of prospects such as thermodynamically favourable energy band levels, tuneable optoelectronic properties, susceptibility to doping at both Ba/Ti sites, and built-in electric field promoting charge separation [3]. Despite these advantages, owing to the wide band gap of undoped $BaTiO_3$, it only harnesses ultraviolet ($\lambda \geq 390$ nm) region that constitutes only 4-5% of the solar spectrum [4]. Hence, extending the optical response of $BaTiO_3$ towards visible/NIR region is essential. Furthermore, owing to its inherent non-stoichiometry, $BaTiO_{3-x}$ has ubiquitous oxygen vacancies and mutually correlated Ti^{3+} defects that promote trapping/recombination, which are loss processes [5]. Therefore, it is essential to gain insight into the defects in $BaTiO_3$ and red-shift the optical absorption. In this work, both the latter-mentioned challenges are addressed by doping $BaTiO_3$ with a rationally chosen d-block metal cation (M^{n+}). Doping red-shifted the optical absorption ($\lambda \leq 700$ nm) and demonstrated a significant enhancement in the photocatalytic H_2 evolution efficiency (under visible light) compared to undoped $BaTiO_3$. Through comprehensive spectroscopic analysis, doping-induced changes in the optoelectronic/surface properties, energetic position of dopant states within the forbidden region, Fermi level shift, and electronic nature of defects that promote H_2 evolution efficiency was revealed. Furthermore, a correlation between the valence state of the dopant with optoelectronic and H_2 evolution rate in undoped $BaTiO_3$ was established. These insights pave the way towards designing efficient photocatalysts for advancing sunlight-driven scalable green H_2 generation efficiency.

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Designing g-C_3N_4 with extended visible-light absorption via co-polymerization

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Keywords: g-C_3N_4, visible-light absorption, photocatalysis, co-polymerization.

Recently, graphitic carbon nitride (g-C_3N_4), a metal-free photocatalyst, has gained significant attention and witnessed rapid growth in the research. It has high thermal/chemical stability, cost-effectiveness, and tuneable optoelectronic properties and can be synthesized with relative ease via polycondensation reaction of carbon and nitrogen rich precursors. Besides, g-C_3N_4 has semiconducting property and can absorb light with optical absorption edge at around 460 nm. g-C_3N_4 is widely used for photocatalytic H_2 production, CO_2 reduction, biomass reformation and environmental remediation [1][2]. Despite these prospects, pristine g-C_3N_4 suffers from low photocatalytic efficiency as it absorbs only a fraction of incoming sunlight in the visible region. To overcome this drawback, it is essential to extend its absorption edge beyond 460 nm. In this direction, copolymerization is one of the approaches that is predicted to increase the extent of conjugation, leading to the redshift of optical absorption in g-C_3N_4 [3]. This work uses organic co-monomers with different functionality and substituted positions with dicyandiamide (precursor) during the synthesis. The obtained copolymerized g-C_3N_4 showed visible light absorption up to 700 nm, as compared to 460 nm for pristine g-C_3N_4. The optical and structural analyses of both pristine and copolymerized g-C_3N_4 samples were conducted. The obtained results offer mechanistic insights into the effect of the copolymerization on the optoelectronic properties of g-C_3N_4. This copolymerized g-C_3N_4 with optical absorption up to 700 nm will be a promising photocatalyst for various applications, for e.g., photocatalytic hydrogen evolution generation.

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Comparative study of structural properties of Gd_2NiMnO_6 and A-site Barium doped Gd_2NiMnO_6

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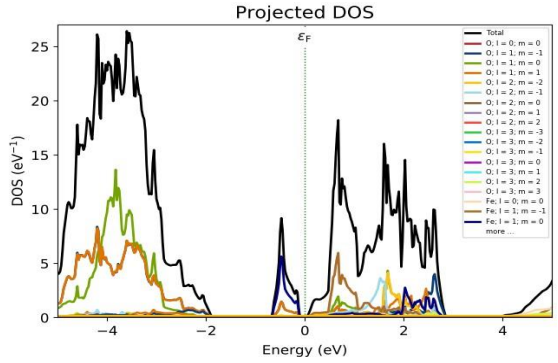
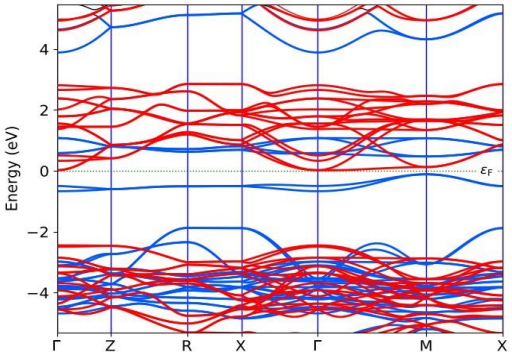
Keywords: Density Functional Theory, Conductivity, Absorption Curve, Chemical potential.

Density functional theory is a powerful tool to investigate the physical properties of materials, including double perovskites, which are promising candidates for fulfilling energy requirements. In this study, we used the effective PBE functional to investigate the electronic and optical properties of Sr2FeMoO6, and estimated its thermodynamic stability using the convex hull approach. Our results indicate that SFMO is a thermodynamically stable material with non-linear optical properties, including anisotropic dispersion, differential rates of absorption, and nonlinearity and dispersion with respect to optical conductivity and dielectric constant. The absorptive bandwidth of the material lies between 2 and 4.5 eV and the absorption function resembles the Gaussian curve. The optical conductivity curve indicates that Sr2FeMoO6 is a direct band gap material with a bandgap of 2.1 eV, and its absorption coefficient peaks at an energy value of 3.2 eV. The material exhibits near-half metallic behaviour with potential applications in spintronic devices, non-volatile memory elements, quantum computing, and faster data processing speeds.





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Ferroelectric And Magnetic Characterization Of Ferroelectric-Ferrite Composite: PZT-Nd Doped Ni-Co Ferrite.

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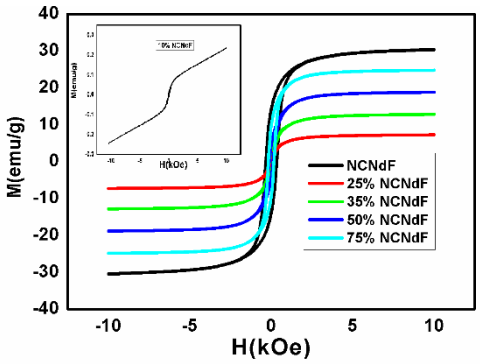
Keywords: Multiferroic, sol-gel, ferrite, ferroelectric.

Ferroelectric–ferrite composites with a remarkable magnetoelectric effect (ME) are the potential candidates for multifunctional device. In the present study we have investigated ferroelectric-ferrite composite based on PZT and neodymium doped Ni-Co ferrite (NiCoNdFO) with general formula x NiCoNdFO-(1-x) PZT (x= 0, 0.10, 0.25, 0.35, 0.50, 1), for their ferroelectric and magnetic properties. The individual phases namely PZT and Nd doped Ni-Co ferrite were synthesized by sol gel technique. To study the ferroelectric properties, P-E hysteresis loops were recorded. The study indicated the influence of the magnetic subsystem on the electrical properties. In the two-phase PZT-NiCoNdFO ceramic composite, the magnetic component causes the decrease in electric polarization. Various magnetic parameters of the composite system were studied and compared to the pure neodymuim doped Nickel-cobalt ferrite. The composites show simultaneous effects of ferromagnetism and ferroelectricity at room temperature, thus confirming the multiferroic behaviour of the composite. The present study demonstrates the possibility of the PZT-NiCoNdFO system as an important multiferroic composite for wide range of applications.



Green Synthesis and Charecterization of Zinc Oxide Nanoparticles Using Aegle Marmelos Leaf Extract

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The present study is focused on the green synthesis of Zinc oxide nanoparticles (ZnO) by Zinc acetate and utilizing the biocomponents of leaves extract of Aegle marmelos [1-2]. The Zinc oxide (ZnO) nanoparticles have been synthesized by a rapid, simple, and eco-friendly method[3-4]. Zinc oxide nanoparticles were characterized using a UV visible spectrometer (UV-Vis),Fourier Transform Infra-Red (FTIR) analysis proved that the particle is of biological origin.The structural and optical properties of nanoparticles were investigated by X-ray diffraction (XRD),Scanning Electron Microscopic Analysis(SEM),The Aegle Marmelos mediated ZnO nanoparticles showed strong antimicrobial activity against gram positive bacteria S.aureus,suggesting that plant based synthesis of nanoparticles can be an excellent strategy to develop versatile and eco-friendly biomedical products.

Keywords: Green synthesis, Zinc oxide nanoparticles, Aegle marmelos.

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Polyethylene glycol-assisted hydrothermal synthesis of hydroxyapatite nanorods for bone tissue engineering

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Keywords: HA nanorods, Hydrothermal, Biocompatible.

Owing to resemblance of hydroxyapatite (HA) nanorods with mineral component of living bone tissue, it attracted appreciable attention as excellent bone material. [1, 2] In this study, rod-shaped HA nanocrystals has been synthesized in presence of polyethylene glycol (PEG) 400 under hydrothermal condition. X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) are used to characterize the composition and morphology of developed HA nanocrystals. Results confirm the formation of HA nanocrystal with rod like morphology. *In vitro* bioactivity of developed HA nanorods has been examined after incubation of HA nanorods pellet in stimulated body fluid at 37ºC. A bone like apatite layer has been formed on the surface of HA pellet after 7 days which shows good *in vitro* bioactivity of HA nanorods. Moreover, MTT result also revealed that HA nanorods demonstrates higher cell viability as compared traditional HA which make the HA nanorods a good biocompatible. These studies clearly show that HA nanorods can be a potential material for bone tissue engineering application.

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MICROORGANISMS AS POTENT CORROSION INHIBITORS

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Microorganisms influence corrosion by changing the electrochemical conditions at the metal/solution interface. Microorganism activity at metal surfaces may result in corrosion induction or corrosion inhibition. There are a lot of microorganisms in the environment, and they can both speed up and partially prevent corrosion of materials. Various bacteria have a potency to protect the metal against corrosion. The physiological actions of microbial secretions over metallic surfaces uphold interfacial physical as well as chemical reactions, not normally favored under abiotic conditions. Utilizing inhibitors is the most effective way to stop corrosion on metals and alloys Organic corrosion inhibitors are toxic to the environment, so researchers have been looking for greener alternatives that are biodegradable and free of toxic metals and chemicals and are both environmentally advantageous and environmentally acceptable.

Keywords: Microorganisms; corrosion inhibitors; bacteria biofilm; green chemistry.

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Evaluation of Heavy Metal Ion Removal Efficiency from Industrial Effluent by Using Nano Impregnated Fungal Hyphae

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Due to increase in population and global climate change the WATER CRISIS problem is at its zenith. In today's world one third of the drinking water requirements are fulfilled by the surface water sources like rivers, lakes dams and canals. Pollution to these water bodies is not only escalating the problem of potable water crisis, but also adversely affecting the environment. Recycling of this water is of paramount importance for sustainable development, environment protection and above all for healthy human life. Industrial effluents, mining, unplanned use of agro chemicals, plastics etc. contaminate the water bodies with heavy metals like lead, mercury etc. All these may cause health disorders like encephalopathy, cancer etc. In general conventional waste water treatment consists of chemical precipitation, ion exchange, redox reaction, reverse osmosis, ultra filtration, electro dialysis, and membrane separation processes. Each treatment process has its own limitation like high cost of design, construction and maintenance, high energy input etc. Nanomatrix embedded bioaccumulating/biosorbing microbes can also be investigated for removal of heavy metal ions from wastewater as this NC will be able for both bioremediation and adsorption.Examples of several nanocomposites such as fungal hyphae and carbon nanotubes microspheres, zirchonium doped fungal biosorbents (*Penicilliumcamemberti, Aspergillusterreus, A. ficuum*), iron oxide nanoparticles and calcium-alginate immobilized *Phanerochaetechrysosporium* etc. are used for removal of various water pollutants such as dyes, heavy metal ions. We are exploring the potential use of nanoimpregnated fungal hyphae for efficient removal of heavy metal ions.

Keywords: Sustainable development, Absorption, Ultrafiltration, Heavy metals, Dye effluent.

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Examining the Benefits of Going Green for Harnessing Energy

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Keywords: Environmental impacts, Renewable energy, Green technology, Energy efficiency, Sustainability.

One of the fundamental requisites at the present is energy; consumed swiftly, demand is increasing, and releases greenhouse gases that contribute to climate change. The role of green technology is to design or modify existing technology in such a way that waste & hazardous substances are mitigated or eliminated completely. At first, every new technology comes with a financial burden, but as our understanding of it deepens, we may learn to accept this cost. In the long run, with advancements in this technology, its cost will be mitigated and this will eventually lead to the utilization of clean, renewable fuels that are readily available in the market, non-hazardous, and sustainable in nature. Green technology has become more prevalent in recent years due to worries about climatic change, global warming and its associated effects-like rising sea levels, extreme weather conditions, drought, energy depletion, and other environmental issues. It has been reported that economies and communities will become more sustainable as sustainable development levels rise. This review explains why green technology for the production of energy should be considered a viable option as it generates fewer greenhouse gas emissions and thus mitigates the effects of climate change, and reduces air pollution and its associated health risks. This paper also describes how with the right technological advancements, energy generated from renewable sources can be stored and used to power our homes and businesses when needed; thus, acting as a reliable and efficient source of energy.

One Pot Green Synthesis of ZnO-CuO Nanocomposite and their Application in Photocatalytic Degradation of MB Dye

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In the present work, plant leaves were used as a stabilizing, capping, and reducing agent for the synthesis of ZnO-CuO nanocomposite and the precursor used in the synthesis of ZnO-CuO nanocomposite was Zn $(NO_3)_2.6H_2O$ and Cu $(NO_3)_2.3H_2O$. ZnO-CuO nanocomposite were characterized using Fourier Transform InfraRed (FT-IR) spectroscopy, X-Ray Diffraction (XRD) spectroscopy, UV–Vis Diffuse Reflectance Spectroscopy (DRS), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray (EDX) spectroscopy and Field Emission Scanning Electron

Microscopy (FE-SEM). The band gap energy of ZnO-CuO nanocomposite was determined by Tauc plot using absorbance data, which was found to be 2.98 eV. Synthesized ZnO-CuO nanocomposite utilized in the photocatalytic degradation of Methylene Blue (MB) dye, showed excellent 99.62 % photocatalytic degradation efficiency and followed pseudo-first-order kinetics.

Keywords: Plant extract, ZnO-CuO nanocomposite, MB dye, pseudo-first-order kinetics.

$AgTiO_3$ SYNTHESIS AND PHOTOCATALYTIC DEGRADATION OF TETRACYCLINE

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KEYWORDS: $AgTiO_3$; Hydro-thermal; Pharma degradation; Perovskite; Photocatalysis; tetracycline.

The environmental pollution caused by pharmaceuticals has aroused worldwide attention due to its negative impacts on the ecosystem and human health. Tetracycline is a type of antibiotic that is frequently found in bodies of water due to its widespread use. Perovskite-based photocatalysis is an emerging technology for combating the water pollution problem. The degradation of non-biodegradable pharmaceutical waste using this perovskite is a novel method of pollutant degradation. In this study, a novel photocatalyst, silver titanate perovskite ($AgTiO_3$), was successfully green synthesized via the hydrothermal method using *Ananas* leaf. This nanomaterial helps in the faster degradation of tetracycline due to its large surface area and reduced bandgap under solar light. X-ray diffraction (XRD) was used to study the crystal structure of the perovskite; the XRD pattern of $AgTiO_3$ confirmed the presence of the anatase phase of TiO_2 and the formation of Ag nanoparticles. SEM was used to study the morphology of $AgTiO_3$, and energy-dispersive spectroscopy (EDS) was used to analyze the elemental composition, where peaks associated with Ag, Ti and O are clearly observed in the spectrum. Also, the photocatalytic degradation of tetracycline was investigated, and it showed excellent photocatalytic activity under UV, visible, and solar irradiation due to its narrow bandgap of 1.34 eV. $AgTiO_3$ nanoparticles degraded more than 95% of tetracycline in 40 min.

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A Lead-Free Perovskite $Na_{0.5}Bi_{0.5}TiO_3$: Investigation on Microstructural, and Dielectric Properties for Actuator Applications

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Keywords: Lead-Free, Relaxor Ferroelectrics, Sodium Bismuth Titanate, Rietveld Refinement, Dielectric Properties.

In the present era, global challenges are focused to meet the security of energy due to excessive energy demands. Coal and petroleum-based fossil fuels are soon fading out and energy from renewable energy sources is becoming an alternative medium. Eco-friendly lead-free polycrystalline $Na_{0.5}Bi_{0.5}TiO_3$ (NBT) was prepared by the solid-state reaction method. The structural and dielectric properties were systematically investigated. NBT sintered at 1100 ℃/1 h and 1150 ℃/1.5 h [1] exhibited a high density of 5.77 g/cm^3 (96% - 98% of the theoretical density). The X-ray diffraction (XRD) pattern of NBT indicates single-phase formation. The Rietveld refinement of XRD data divulged that the composite systems have Rhombohedral and Tetragonal phase present in the solid solution. For the rhombohedral phase (R3c), lattice parameters are $a = b = 5.5318$ Å, $c = 13.5132$ Å and volume percentage = 64.21%. Whereas, for the tetragonal phase (P4bm), lattice parameters are $a = b = 5.5385$ Å, $c = 3.8865$ Å and volume percentage = 35.79%. From temperature-dependent dielectric measurements, the frequency dispersion is visible in the first (~70 °C) and second humps (T_m = 315 °C) along with peak broadness, which confirms the relaxor nature due to the presence of Polar Nano Regions (PNRs). The main reason behind the origin of PNRs is due to the compositional inhomogeneity of the different cations Na^{1+} and Bi^{3+} on the A-site [2]. The diffusivity parameter (γ) is found to be 1.65. The dielectric loss (tanδ) shows the same frequency dispersion in the temperature region as dielectric permittivity. The depolarization temperature (T_d) was found to be ~188 °C. NBT exhibits high maximum permittivity of 4267. The burns temperature (T_B) found from the inverse of the dielectric permittivity curve are 390 °C. These excellent properties demonstrate the potential of NBT ceramics for actuator applications.

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The effect of Barium doping on Structural, Dielectric, and Ferroelectric properties of $SrBi_2Nb_2O_9$-$Bi_4Ti_3O_{12}$ Aurivillius ceramics

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Keywords: Aurivillius oxides, intergrowth, dielectric properties, ferroelectric properties.

Bismuth Layer Structured ferroelectrics (BLSF), owing to their various environmentally friendly lead-free compositions, and their distinctive natural superlattice-like structures have sparked increasing interest in both fundamental and application perspectives [1][2]. The Ba-modified SBN-BIT intergrowths $SrBi_{2-x}Ba_xNb_2O_9$-$Bi_{4-x}Ba_xTi_3O_{12}$ (x = 0.00, 0.02, 0.04, 0.06, 0.08, and 0.10) have been synthesized using a conventional two-step calcination process. The effect of Ba substitution in SBN-BIT intergrowths on its structural, dielectric, and ferroelectric properties was investigated. X-Ray diffraction and Raman scattering were employed to identify the phase and doping sites. Rietveld analysis of XRD data has been done to calculate the lattice parameters. Microstructural analysis, using Scanning Electron Microscopy (SEM) confirmed the dense plate-like morphology of ceramics pellets.

Dielectric and electrical properties were studied as a function of temperature RT-720 °C and frequency in the range 20Hz-1MHz. The ferroelectric nature of Ba-doped $SrBi_{2-x}Nb_2O_9$-$Bi_{4-x}Ti_3O_{12}$ ceramic samples was examined by room-temperature ferroelectric hysteresis.

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Investigation of optical and electrical transport properties of $KBiFe_2O_5$

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Keywords: Brownmillerite, Magnetization, dielectric transition, photocatalysis.

The multiferroic $KBiFe_2O_5$ (KBFO) has upcoming brownmillerite structure. It has monoclinic crystal structure and prepared using solid state reaction method [1] .The calicinated temperature have important role for determining the optical properties. This compound $KBiFe_2O_5$ exhibited spontaneous polarization with illumination by visible light, which causes separation of charges which will helpful for Sunlight driven photocatalysis application. The material synthesized at the temperature 750^oC resulting an optical band gap of 1.72 eV. The real and imaginary part of dielectric constant is measured by using impedance analyzer. The magnetic and dielectric transition occurs in the temperature range nearly 740K- 800K, will be presented at the conference.

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Eco-friendly synthesis of novel Graphene Oxide and reduced Graphene Oxide and exploring its antimicrobial application

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Keywords: Modified Hummer's method, rGO, Antimicrobial activity, E-coli

From past few decades Graphite and its derivatives (Such as Graphene, Graphene oxide and reduced graphene oxide) are the most researched materials due to their novel, extraordinary, remarkable and promising properties. To control the transmission of harmful microorganisms, there is need to have a strong antimicrobial and antibacterial reagent, this is being the main focus of this study. In this recent

study, for the synthesis of Graphene oxide used a simple modified Hummer's method. In this method we have avoid use of Sodium Nitrate, as its use will result into the evolution of hazardous gases like NO_2 /N_2O_4 [1]. Further we have used a strong reducing agent [2] for the reduction of this graphene oxide to form reduced Graphene Oxide (rGO). Raman Spectroscopy, X-Ray diffraction, FTIR are used for the confirmation of Graphene oxide and rGO. Also to get the structural morphology information we have done SEM and TEM characterizations. In the recent study, we wanted to explore the antimicrobial activity of novel graphene oxide and rGO. We have used E-coli for the current study. The study shows formation of stable Graphene oxide and rGO and its microbial activity were studied on bacteria E.coli.

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Investigation of room temperature exchange spring behavior in $SrFe_{12}O_{19}/CoFe_2O_4$ nanocomposites.

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Keywords: exchange spring, maximum energy product, nanocomposites, permanent magnet.

The exploration of the exchange spring behaviour between hard and soft magnetic materials has been proposed for enhancing the maximum energy product of oxide based magnetic systems, with the aim of extending their use to all applications where moderate energy product is sufficient. Spinel Cobalt ferrite (CF) and Strontium hexaferrite (SF) composites is particularly promising, although the optimized conditions to maximize the energy product have not yet been identified. Within this framework, the optimization of the structural and magnetic properties of the soft and hard ferrites before the coupling procedure is crucial to enhance the energy product of the final composite [1-3]. Here we report the syntheses of Cobalt ferrite (CF) and Strontium ferrite (SF) nanopowders by hydrothermal method and Sol Gel Auto combustion method. X-ray Diffraction studies confirm the formation of spinel $CoFe_2O_4$ and hexagonal $SrFe_{12}O_{19}$ ferrites with average crystallite size were 45.23 nm and 45.93 nm. The composites were prepared by using these phase pure soft and hard ferrites. The soft phase in the composite varied from 5 wt% to 30 wt%. The X-ray diffraction data confirmed the presence of independent phases, with absence of intermediate phases. Room temperature magnetization data exhibited single hysteresis loop and confirms the presence of exchange coupling between the two phases.

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A green approach for valorization of SCB via *Psuedomonasmendocina* NITDDGIFE11 treatment for the production of Cellulose Nanoparticles

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KEYWORDS: Cellulose Nanoparticles (CNPs), Pseudomonas mendocina NITDDGIFE11, Sugarcane Bagasse, Vigna radiate.

Sugarcane bagasse (SCB), the solid waste of the sugarcane industry is now realized as an important bioresource as it can act as a renewable, low-cost source of cellulose (40–50%) with diverse applications. Apart from the conventional use, there are different reports to convert it into other valuables such as biochar, activated carbon, hydrogel, carboxymethylcellulose (CMC), cellulose nanoparticles (CNPs) and nanocrystalline cellulose. For sustainable management of this waste and improvement towards bioeconomy, in this study, a green strategy was attempted where the bacterial transformation of the SCB with the *Pseudomonas mendocina* NITDDGIFE11 was done in a batch mode for the extraction of cellulose. The recovered cellulose (34%) was converted into cellulose nanoparticles (CNP) following standard protocol and characterized via FE-SEM. DLS, XRD, FTIR and TGA. FE-SEM showed CNP to be spherical, DLS revealed particle size to be within 100 nm, and the cellulose crystalline nature was found in XRD with 2Θ value at 21.816°. Additionally, the analysis of antioxidant activities and favorable interaction with cells revealed CNP's various unique properties for biomedical use. Investigations on CNP's potency as a drug delivery system along with its non-toxic nature in cells and plants will help it to be utilized significantly.

POSSIBLE FINE TUNING OF METHANE ACTIVATION TOWARDS C2 OXYGENATES VIA 3d- TRANSITION METAL-IONS DOPED CERIA-ZIRCONIA

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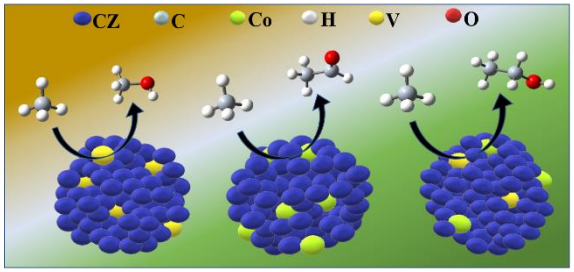
Keywords: Heterogeneous catalysis; Partial oxidation; Natural gas; Nano-catalysis; C-C coupling.

We have demonstrated a simple sol-gel method to synthesize 3d- transition metal-ion(s) doped ceria-zirconia (CZ) solid solution for efficient catalytic methane activation. Methane activation with Mn, Fe, and Cu mono-metal ion-doped CZ favors C1 oxygenates, while Co doped CZ assists C-C coupling with the formation of acetaldehyde. This is further promoted by the Co+ V bi-metal ion combination that shows ethanol as the major product along with methanol, methyl hydrogen peroxide, and formic

acid as minor products. An impressive ethanol yield of **213 µmol/g.h** with 86% selectivity obtained with 4 atom% Co+V bi-metal ion-doped CZ catalyst is at par with that obtained with noble metal-based catalyst under comparable reaction conditions. The partial oxidation of CH_4 in Co-based bi-metal combinations suggests a synergistic effect of doped metal ions owing to the heterogeneous near-neighbor environment. Present results are attributed to surface heterogeneity between the host and dopants, which selectively promotes methane activation as well as C-C coupling. This indicates a lot of scopes to tune the activity of partial activation of methane and product selectivity with different metal-ion(s) combinations.

TOC



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Cr Substituted CdSe Diluted Magnets as a Dual Imaging Probe

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Keywords: Quantum dot; Diluted magnets; dual imaging probe; MRI.

Substitution of semiconductor QDs by transition-metal ions having magnetic properties was pronounced as diluted magnetic semiconductors (DMS).Due to the balance of optical and magnetic properties these DMS was applied in various fields such as spintronics, bio-imaging and MRI. However, stabilizing structural, optical and magnetic properties of nanocrystals in water play a crucial role in synthesis of DMS. Therefore, here in our work we have developed a facile substituted synthesis route for Cr-CdSe DMS magnetically doped with Cr via a simple hydrothermal method. The effects of doping on structural, optical, and magnetic property were studied using XRD, UV-Visible

spectroscopy, Photoluminescence, Lifetime. Advanced characterization like TEM and XPS was performed to study the insight chemical oxidation information and change in morphology with increase in doping concentration. Furthermore, cell imaging and MRI studies were performed to understand the capability of Cr-CdSe as a dual imaging probe.

Preparation & Characterization of PVA/Starch /Clay Composite for packaging application

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Keywords : Food packaging, Starch, Poly (Vinyl Alcohol), Clay.

Most of the packaging materials are based on petroleum product. Conventional packaging materials have problem with recycling and renewability, so that we have to find out substitute materials that can be used for food packaging application. Poly (Vinyl Alcohol) has a good film forming property for packaging, but it has weak mechanical and barrier properties so that improvement is required to make better choice for food packaging material. The main aim is to prepare PVA/Starch/Clay composite for food packaging application The nanocomposites film prepared by solvent casting method and characterized by SEM, XRD, FT-IR, UV-vis spectroscopy. The mechanical and barrier properties of nanocomposite have been improved when it compares to neat PVA film. The result showed that PVA/Starch/Clay film had higher tensile strength than PVA/Starch and PVA film.

Detection of *Candida albicans* responsible for urinary transmitted infection in real samples using peptide-based biosensor

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Keywords: Peptide, Biosensor, Nanotechnology, Candida albicans, biomarker.

Infectious diseases posed a serious health threat prior to the discovery of antibiotics and antifungal agents. However, without knowing the microbe responsible, indiscriminate use of drugs resulted in the selection of antibiotic-resistant microbes [1]. Quick detection and accurate identification of the pathogenic microbe, therefore, is essential. Urinary tract infections (UTIs) are recurring type of infections and need proper diagnosis and treatment. In recent decades, there has been an increase in the percentage of UTIs caused by fungi. *Candida albicans* happens to be the most prevalent of all *Candida spp*. responsible for UTIs. It is essentially important to differentiate between several Candida strains at the species level, for appropriate diagnosis and therapy. We propose to develop a peptide-based biosensors that could quickly detect and identify the microbe. Candidalysin is a secreted peptide toxin released by *Candida albicans* and has a high potential as a diagnostic marker [2]. The peptides specific to it, are being identified using molecular docking as well as through phage-display and mirror-phage display techniques. The selected peptide will be immobilised on the bioelectronic electrode surface, using several methods, including deposition or coating the surface with gold nanoparticles, multiwall carbon nanotubes, and reduced graphene oxide. The overall work of the project is represented in Fig 1.

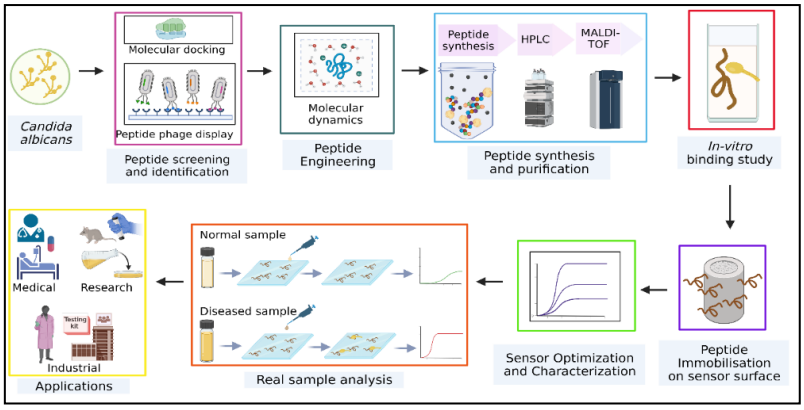

Fig1. Workplan of the project

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Effective ammonia electrosynthesis and energy conversion by Zn-nitrate battery

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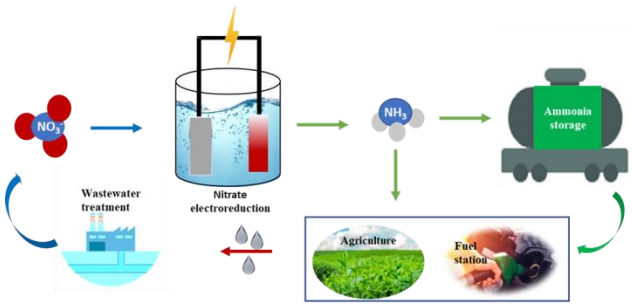
Keywords: electrochemical, ammonia, nitrate reduction, Zn-nitrate battery.

Ammonia (NH_3) is one of the most significant compounds that are frequently used in industry and agriculture as a raw material and can even be utilized as green energy carrier.[1, 2] The energy-intensive Haber-Bosch process for ammonia synthesis can be replaced by the environmental-friendly electrochemical conversion of nitrate, a common water contaminant and can also be utilized as nitrate-based voltaic cells, which produces both energy and NH_3.[3] However, this aqueous nitrate reduction process not only faces intense competition from the hydrogen evolution reaction (HER), but also produces undesirable by-products, emphasizing the critical importance of researching effective catalysts for NH_3 synthesis.[4] Herein with the Cu-doped Fe_2O_3 with nitrogen containing carbon matrix ($CuFe_2O_3$/NC) as a NO_3^- reduction catalyst cathode, a Zn-nitrate battery is said to provide a "hitting three targets with one arrow" strategy for energy supply, ammonia synthesis, and pollution removal. $CuFe_2O_3$/NC displays faradaic efficacy of 90.34 % and 2.14 mg h^{-1} mg_{cat}^{-1} of NH_3 yield. Further this catalyst was utilized as cathode material and the assembled Zn-NO_3 battery exhibits a high-power density of 18.28 mW cm^{-2}. This work enhances the utilization of Zn-based batteries in the field of electrocatalysis and features the commitment of bimetal catalyst for the NO_3^- reduction.



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Structural and optical study of pure CuI thin film by thermal evaporation technique

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Copper iodide (CuI) thin films are grown on silicon substrates using a horizontal thermal evaporation system, and the effect of gas flow on CuI thin film properties is thoroughly discussed. The X-ray diffraction (XRD) study confirms its polycrystalline nature and the γ-phase of CuI. A photoluminescence (PL) measurement system was used to know the optical behaviour. The electrical study is done by Hall measurement, and its lowest resistivity is 3×10^{-1} Ωcm with hole concentration of 3.2×10^{19} cm^{-3} and mobility of 27 $cm^2V^{-1}s^{-1}$. These results indicate that the high-purity CuI thin film by thermal evaporation can be used in different optoelectronic applications.

Keywords: CuI; XRD; PL; Thin film; Optoelectronics.

Tuning of the Structural, Morphological and Dielectric properties of the Yb 2 NiMnO6 double Perovskite by Ca doping

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Keywords: X-Ray Diffraction, morphology, dielectric.

The effect of replacing ytterbium with calcium in A site of the Yb_2NiMnO_6 perovskite on Structural Dielectric and Morphological was examined in this study. Solid state reaction mechanism was applied for the synthesis of materials. X-Ray diffraction was adopted to determine the phase of the samples that revealed the orthorhombic structure with pnma space group as verified by the Rietveld

refinement. Scanning electron microscope images of the samples show reduction in grain size after doping with Ca^{+2} ions. The grain size and grain boundaries play a vital role on temperature and frequency dependence of the dielectric properties. A huge enhancement in dielectric constant accompanied with diminished dielectric loss was found by increasing the concentration of dopant. Thus improvement in dielectric properties indicates that samples can be used in high frequency applications.

Structural and spectroscopic analysis of Dy^{3+} doped ZrO_2

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Keywords: Zirconia; XRD; FTIR; UV-Vis.

The three phases of zirconia: monoclinic, tetragonal, and cubic are significant ceramic materials. The remarkable optical characteristics of the rare-earth-doped zirconia materials have led to their widespread application such as in solid-state lighting. In contrast to traditional lighting sources like halogen lamps and compact fluorescent lights, solid-state lighting uses less energy and has just improved the lighting market [1]. Currently, there are several applications for phosphor-converted LEDs in automobile illumination and interior and outdoor lighting [2]. The solution combustion process was employed to produce powders of ZrO_2 and ZrO_2:Dy^{3+} at different molar concentrations of Dy^{3+} ions. The synthesized series was characterized structurally using XRD, vibrationally using FTIR, and optically using PL, and UV-Vis spectroscopy. The tetragonal crystal structure was obtained in the XRD pattern. The presence of metal-oxygen bonding in the synthesized material was evident through FTIR analysis. The Zr-O vibration mode of the t-ZrO_2 phase was present, as per FTIR spectra. The Dexter energy transfer formula was utilized to investigate the mechanisms underlying the concentration quenching phenomena observed in the PL result.

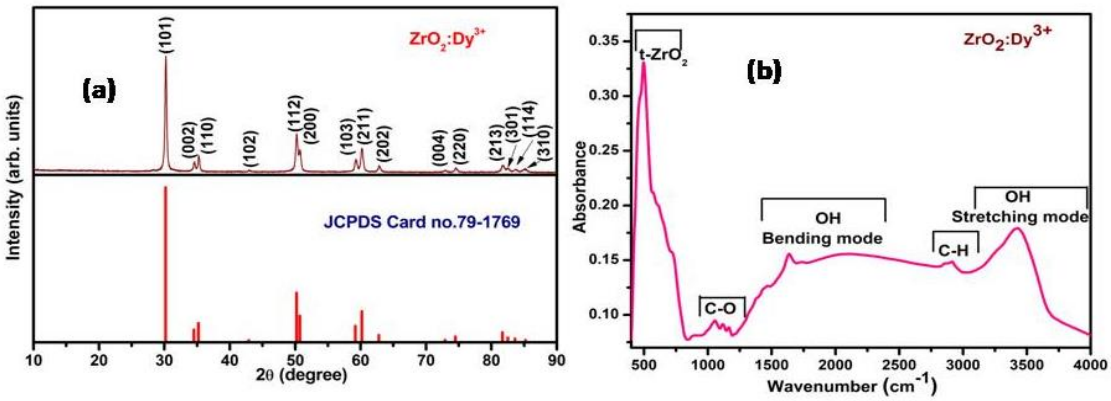

Fig. 1 (a) X-ray diffraction pattern of ZrO_2:Dy^{3+} and (b) Fourier-transform infrared spectrum of ZrO_2:Dy^{3+}

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Profile: Auther is working as Assistant Professor in School of Physics, Shri Mata Vaishno Devi University Katra, Jammu and Kashmir. His area of interest is materials science mainly focused on florosecent materials.

Synthesis and characterization of $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_{0.x}O_{3-\delta}$ based composite cathodes for IT-SOFCs

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Keywords: solid oxide fuel cells, cathode materials, electrolyte, conductivity.

Decreasing SOFCs working temperature to 500°C–700°C is a primary concern for current fuel cell research.[1-3] Unfortunately decrease in operating temperatures lead to increase in cathode polarization, which deteriorates electrochemical activity of the cathode for oxygen reduction reaction. Therefore, exploring novel cathode materials is one of the critical bottle necks towards the development of IT-SOFCs. A perovskite oxide $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ - $Gd_{0.}Ce_{0.9}O_{2-\delta}$ has been investigated as a novel cathode for intermediate-temperature solid oxide fuel cells (IT-SOFCs). $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ was synthesized by solid state reaction method, by varying x from 0 to 0.10. The phase purity of as prepared $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ powders was evaluated by powder X-ray diffraction with Cu-K_α radiation. No additional phases and peak shifts were detected, which confirms phase purity of the prepared all the $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$. Rietveld refinement was performed on all as prepared cathodes. The calculated lattice parameter *a* and cell volume *V* are found to vary from 0.3941 *nm* to 0.3960 *nm* and 61.4 $Å^3$ to 62.1 $Å^3$ respectively. The reliability factors 2 to 4 indicate that the refinement results are reasonable and all the $Bi_{0.5}Sr_{0.5}Fe_{1-x}Sn_xO_{3-\delta}$ oxides shows the cubic structure with space group $Pm\bar{3}m$. Scanning electron microscopy (SEM) was performed to analyse surface morphology. Electrochemical Impedance spectra (EIS) from room temperature (RT) to 600 °C confirms enhancement of the electrochemical performance of BSFC cathode materials. The detailed investigation results will be presented at the conference.

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The role of Nano-grain size vs bulk in low/high energy ion irradiation at room temperature induced modifications and radiation tolerance

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Keywords: Inert matrix fuels, nuclear reactors, electronic energy loss, nuclear energy loss, radiation tolerance.

Understanding the radiation tolerance of ceramics against Swift heavy Ion (SHI) and low-energy heavy ions is crucial for evaluating their tolerance to nuclear fission and alpha recoils, respectively, which are a substantial cause of damage for their use as nuclear fuels and/or waste immobilization matrices. In addition to their crystalline structure, particle size and microstructure have a considerable influence on the radiation response of ceramics [1]. Ceria, which is isostructural to UO_2, is mostly used as inert matrix fuel (IMF) in nuclear reactors [2]. The radiation tolerance and response of 5-

mol% of Gadolinium doped Ceria (GDC) against both electronic energy and nuclear energy loss regime has been critically analyzed to examine its compatibility and structural changes against an ion beam irradiation. A range of techniques including Glancing Angle X-ray diffraction (GIXRD), field emission scanning electron microscopy (FESEM), Transmission electron microscopy (TEM) and Raman Spectroscopy were employed to characterize the GDC. With the aid of Rietveld refinement analysis and inelastic thermal spike simulation (i-TSM), the radiation tolerance behaviour of the samples is explored, which suggests greater transient lattice temperatures with longer durations following irradiation, hence leading to the damage inside the material in the form of cylindrical ion track due Swift heavy ions beam Irradiation. In the case of the single ion beam high energy irradiations, the material modification (viz. degradation in long-range ordering (i.e., damage)) was found to be significantly higher for the nano-crystalline state as compared to bulk at room temperature. These observations are strikingly opposite to results obtained with low energy irradiations. Upon the low energy ion beam irradiations, the material modification (i.e., degradation in the long-range and short-range ordering) is lesser in the nano-crystalline samples as compared to their micro-crystalline counterpart, hence indicating better damage tolerance of the nano-crystalline state as compared to bulk one. This one-of-a-kind study thus also provides realistic evidence towards the potential application of nanomaterials over bulk for nuclear reactor applications where simultaneous irradiation with low and high-energy particles correspond to the actual irradiation situation that materials encounter.

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Synthesis and Characterization of Polymer Coated Iron Oxide Magnetic Nanoparticles for their potential use in Magnetorheological fluids

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Keywords: Smart Fluid, Co-Precipitation, Chemical Oxidative Polymerization, Core-Shell structure.

Implementation of Spinel Ferrites has proven to be a major advantage in the field of smart materials such as magnetorheological fluids but maintaining their stability has been a major issue inhibiting their use in wide range of applications [1]. Coating of Polyaniline on Fe_3O_4 nanoparticles results in the increased sedimentation stability of Magnetorheological fluids. In the current study, we have synthesized Iron Oxide (Fe_3O_4) nanoparticles and Polyaniline for their usage in the Magnetorheological Fluids. Fe_3O_4 Nanoparticles has been prepared using Co-Precipitation technique whereas Chemical Oxidative Polymerization technique has been employed for the synthesis of conductive polymer Polyaniline. Resulting core-shell structure of Fe_3O_4 – Polyaniline results in the increased sedimentation stability of the Magnetorheological fluid. X-Ray Diffractogram (shown in the Fig. 1 and Fig. 2) confirms the formation of Fe_3O_4 nanoparticles and Polyaniline. Morphology and grain size information of Polyaniline has been obtained using Field Effect Scanning Electron Microscope. FTIR spectroscope was used to analyze the chemical composition of both Fe_3O_4 and Polyaniline.

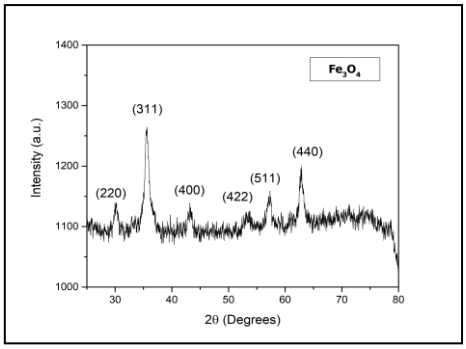

Fig. 1: XRD Diffractogram of Fe_3O_4

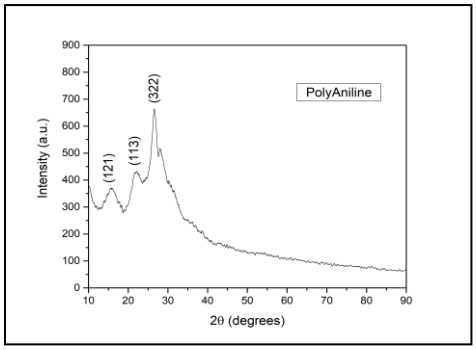

Fig. 2: XRD Diffractogram of PAni

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Synthesis and Characterization of Spinel Ferrite Magnetic Nanoparticles for Photocatalytic degradation of dyes

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Keywords: Photocatalytic Degradation, Spinel Ferrites, Photocatalyst.

Spinel Ferrite Magnetic Nanoparticles have been widely used in various applications including wastewater treatment for the photocatalytic degradation of organic dyes. Although there are many challenges which arises during this process. Among all these challenges, the difficulty in recovering the photocatalysts from the solution has been improved by synthesizing magnetic nanoparticles. Nickel Ferrite and nanocomposite of Fe_3O_4/GO have been synthesized using hydrothermal process and various characterizations like XRD, Fe-SEM and UV-VIS Spectroscopy have been employed for the confirmation of these ferrite nanoparticles. X-Ray Diffraction graph for Nickel ferrite representing peak at different 2θ values confirms the formation of spinel structure of Nickel ferrite [1] as shown in fig.1 and the nanocomposite of Fe_3O_4/GO confirms the formation of modified GO along with spinel structure of Fe_3O_4 as shown in fig 2. The crystallite size of Nickel ferrite and Fe_3O_4/GO was calculated using Scherrer's equation and came to be around 17 nm and 33 nm. UV-VIS spectrophotometer was used to calculate the band gap of these nanoparticles

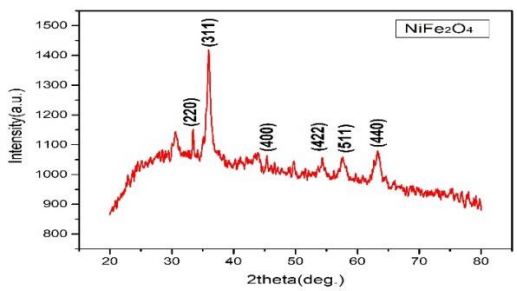

Fig. 1: XRD graph of Nickel Ferrite

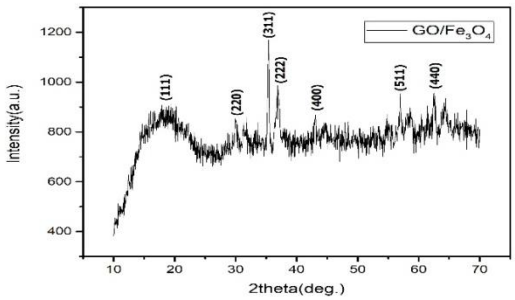

Fig. 2: XRD graph of Fe_3O_4/GO

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The influence of dipolar interactions in nano magnetic nano fluid's viscosity in static magnetic field

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Keywords: Nano magnetic fluids, dipolar interactions, meson number, Herschel bulkley model.

Ferrofluids are smart colloidal suspensions of tiny nanoparticles dispersed in base fluids in the size range of 1-100nm. The ferrite's Fe_3O_4 magnetic nanoparticles are coated with surfactant (oleic acid) and dispersed in kerosene are made using a two-step co-precipitation technique. After that, the produced nanoparticles are analyzed structurally and morphologically. The single phase with nanometric crystalline size of nanoparticles is confirmed by the XRD and FE-SEM techniques. The enhancement in viscosity is observed in the presence of the increasing static magnetic field as the Brownian motion of the nano-particles is being transformed into the chain structures with the application of the magnetic field. The effect of the dipolar interactions on the behavior of nano magnetic fluids under shear flow is not well understood. Weak and strong shear flows in the presence of a static magnetic field are used to examine how these macroscopic features depend on the dipolar interactions in nano magnetic fluids. At high shear rates the rupturing of the column to chain structures occurs that eventually decreases the viscosity of the nano magnetic fluids. This is a key feature in a nano magnetic fluid that structural and dynamic properties can be switched with the application of applied magnetic fields. Herschel bulkley model is used to fit the rheological data of the nano magnetic fluid.

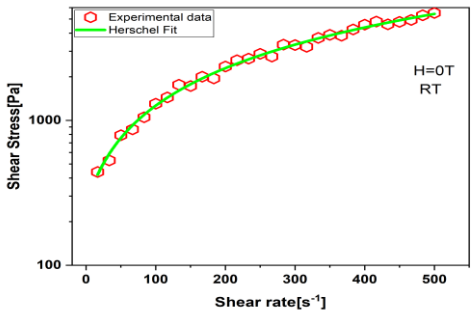

Figure 2. Herschel fit of the viscosity at 0T at room temperature

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Study of the Compression Behaviour of FeCrTiSn and FeCrTiSb Using Various Equations of States

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The Heusler compounds assert potential candidates for a variety of applications such as memory devices, spintronics, magnetoresistive materials, and spin-value generators owing to their undeniable properties such as large magnetic moment, large ferromagnetism, Curie temperature, high polarization at the Fermi level, thermoelectric performance, etc. In this work, the theoretical approach wherein various equation of states such as Tait, Murnaghan, Shanker, Kohliya and Chandra have been employed to investigate the compression behaviour of the two Heusler compounds FeCrTiSn and FeCrTiSb in detail. It has been observed that both the compounds FeCrTiSn and FeCrTiSb exhibit a nearly linearly declining trend with the applied pressure and our theoretical results are in agreement with experimental calculated one reported in the literature.

Keywords: Heusler compounds; Bulk Modulus; Pressure, Equation of State

CO_2 utilization in a microbial electrosynthesis cell for synthesis of value-added products

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Keywords: Carbon dioxide, Microbial electro-synthesis, Volatile fatty acids.
This study presents a new approach for the bio-electrochemical conversion of carbon dioxide into volatile fatty acids, specifically acetic acid, through the use of mixed culture anaerobic microorganisms in a two-phase process. The first phase involves the implementation of an electrochemical cell comprising of an anodic chamber and a cathodic chamber separated by a cation exchange membrane. The mixed culture anaerobic microorganisms act as catalysts for the conversion of carbon dioxide into acetic acid and other metabolic products. The second phase consists of the separation of fatty acids from other metabolic products. The results of this study demonstrate the potential of this bio-electrochemical conversion process as a sustainable solution for reducing carbon dioxide emissions using renewable energy sources such as solar energy while simultaneously producing useful chemicals for further synthesis of value-added products. Several parameters for optimizing the performance of the process were optimized for maximum conversion of carbon dioxide into acetic acid.

A greener approach towards graphene oxide reduction: synthesis, characterization of biologically reduced- graphene oxide (BrGO) and applications thereof.

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Graphene oxide (GO) and its derivatives reduced form (rGO) possess good electrical conductivity, mechanical stability and intrinsic biocompatibility therefore, their potential use in biomedicine is remarkable. However, the conventional method of rGO synthesis usually involves the use of toxic

reducing agents which are harmful to human health and the environment. Thus, there is a need for greener approaches for the effective reduction of GO suitable for its various applications. In this study, novel natural materials were selected that acted as reducing agents in the synthesis of biologically reduced Graphene Oxide (BrGO) in order to replace the toxic chemicals otherwise used. Biologically reduced samples *viz* BrGO-P, BrGO-S, BrGO-M and BrGO-T were obtained using four different natural materials by hydrothermal treatment of GO synthesized using modified hummer's method. Further, as-synthesized samples GO, BrGO-P, BrGO-S, BrGO-M and BrGO-T were subjected to various physical and morphological characterization methods such as UV-Visible spectroscopy, FTIR, Raman, X-ray diffraction (XRD), Thermogravimetric Analysis (TGA), FESEM-EDS etc. Preliminary results indicate that greener approach and protocol developed in this study for obtaining biologically reduced-graphene oxide (BrGO) is quite effective. Further, the optimized as-prepared samples were evaluated for their capacity to remove dyes from water using Rhodamine 6G (R6G)) dye solution. Our results showed that our materials have excellent R6G dye removal efficiency and have potential to be utilized for removal of harmful dyes from different industries.

Synthesis, characterization of silver nanoparticles using extracts of medicinal plant *Rhodiola* and applications thereof

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Green synthesis of metal nanoparticles using plants has been recognized as a non-toxic and efficient method for applications in the biomedical field. In this regard, silver nanoparticles (AgNPs) with diameters ranging from 1to100 nm are considered to be important due to their unique properties, and extraordinary range of anticancer and other therapeutic abilities.

The aim of this study was to investigate the role of *Rhodiola* extracts prepared in different solvents for biological synthesis of AgNPs. We prepared extracts of *Rhodiola* plant in solvents of differential polarities and performed qualitative phytochemical screening for detection of phenols, triterpenoids, reducing sugars, flavonoids, tannins, phytosterols, quinines and terpenoids in order to determine various phytoconstituents that could act as bioactive reducing and capping agents in the green synthesis of AgNPs. Considering the role of oxidative stress in the pathology of several diseases and the use of antioxidants for treatment in various diseases, antioxidant ability of as-prepared extracts was determined using DPPH (2,2-diphenylpicrylhydrazyl) assay, and also by the FRAP (Ferric ion reducing antioxidant power) method. Moreover, total phenolic and flavonoid content was also determined for extracts showing the best antioxidant activity. Further, the extracts were evaluated for their *invitro* anticancer activity on various cancer cell lines *viz*: A549 and C4-2. The role of biomolecules in *Rhodiola*, which supports the formation of AgNPs from cationic silver, was tested under different physicochemical conditions to optimize the conditions such as pH, reaction time and reactants concentration. The size, shape, morphology, and stability of the as-synthesized AgNPs were investigated by UV-Visible spectroscopy, Dynamic light scattering (DLS), X-ray diffraction (XRD) and Scanning electron microscopy (SEM). Preliminary results from this study indicate potential applications of *Rhodiola* plant organs in the green synthesis of silver nanoparticles. Also, *Rhodiola* plant extract significantly inhibits the cell viability in both the cancer cell lines *in-vitro,* which indicates the potential of using *Rhodiola* plant organs and synthesized AgNPs using *Rhodiola* extracts for the development of effective anticancer therapeutics.

Low temperature electrical characteristics of Mn doped $RFeO_3$ (R= Pr and Eu) systems

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Keywords: Perovskites, Morphology, Dielectric, Conductivity, Hopping.

$RFeO_3$ (where R = rare earth metals) belongs to perovskite family and have ABO_3 distorted orthorhombic perovskite structure with space group *pbnm.* In this structure, the distortion of the Fe octahedron is small and almost independent of 'R' (rare earth ion) [1]. But the distortion of rare earth polyhedra is large and increases with decreasing ionic radius of R. Such structural distortions influence the physical properties of such systems. In Orthoferrites, $RFeO_3$ appear as a potential candidate in microelectronic industry as it enables device miniaturization due to the high dielectric constant (ε') and low dielectric loss (tanδ). Polycrystalline bulk samples of $RFeO_3$ (Pr and Eu) doped with Mn at Fe site were synthesized by solid state reaction method. $RFeO_3$ shows remarkable electrical and magnetic properties due to mixed valency. The results of dielectric study show there is improvement in electrical properties especially at higher doping and the dielectric constant can be sensitively controlled by Mn substitution. For higher doping concentrations, both dielectric constant as well as dielectric loss shows a relaxor type of behavior in $PrFeO_3$ (PFO). The dielectric properties of Mn doped $EuFeO_3$ (EFO) have also strong dependence on both temperature and frequency of the applied electric field. The absence of any loss peak in the dielectric dispersion of the material suggests its behavior to be that of quasi-dc process (QDC). The conductivity measurement shows that samples of EFO series obeys Jonscher's universal power law. In both the samples the ac conductivity alteration identifies that the conduction mechanism follows the charge hopping between localized states and follows small polaron conduction [2-3].

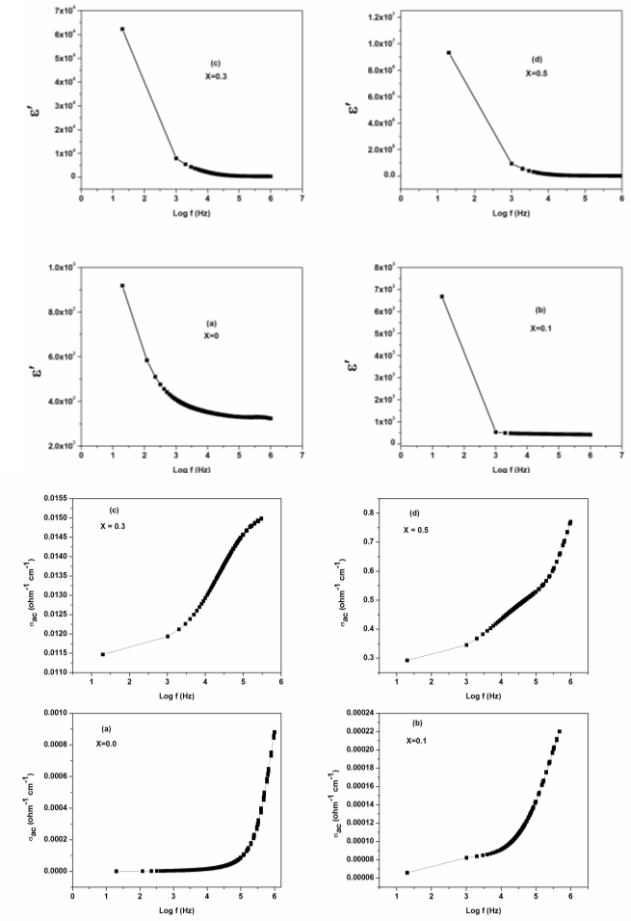

Fig. 1: Frequency dependence of Dielectric constant and ac conductivity in Mn doped PFO

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[**Dr. Khalid Sultan** is an Assistant Professor in the Department of Physics, Central University of Kashmir. He has been awarded Ph. D in Physics from NIT Srinagar. Dr. Khalid has qualified CSIR-NET/JRF twice and is a recipient of various awards. Dr. Khalid has been felicitated by the Honorable President of India for his research work. Dr. Khalid Sultan has recently published a book titled "Practical Guide to Materials Characterization: Techniques and Applications" with WILEY USA. He has a good number of publications in National and International Journals of repute. Dr. Sultan has supervised four M. Phil scholars and is presently guiding five Ph. D scholars.]

Nano-particle of Ni-Cu alloy for detection of ascorbic acid, dopamine uric acid, guanine and adenine in a mixture simultaneously

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Nanoparticle of bimetallic NiCu were used as a modifier of graphite loaded acrylate polymer electrode for the detection of ascorbic acid (AA), dopamine (DA), uric acid (UA), guanine (G) and adenine (A). All these bio-molecules are important for medical diagnostic in order to know the status of the diseases. The nanoparticle of alloys was prepared by chemical reduction of $NiCl_2$ and $CuCl_2$ in water using $NaBH_4$ as reducing agent. Variation of Cu and Ni salts showed that 1:1 atomic ratio of Cu and Ni had the highest efficacy. The metal powder was characterized by XRD, FESEM and EDS. The morphology and structural characterization showed that sizes of alloy nanoparticle ranges from 20-40 nm with narrow size distribution . The powder released a larger specific surface area with an extraordinary electro-catalytic activities and higher sensitivity , wide linear range of detection , low detection limits, good reproducibility and stability. The linear response ranges for the determination of AA, DA, UA, G and A were 30–2000 µM, 0.35–50 µM, 0.6–200 µM, 0.5– 500 µM and 0.5–550 µM with the detection limits (S/N = 3) of 10 µM, 0.02 µM, 0.08 µM, 0.2 µM and 0.2 µM, respectively. The proposed sensor was also employed to determine these molecules in real samples, such as vitamin C tablet, dopamine injection, urine from pathology laboratory, hydrolysed DNA and produced satisfactory results. The sensor has a scope for analysis of complex biological fluids .

Keywords: Nanoparticles; modified acrylate polymer; electrochemical sensor; Bimetallic NiCu

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Nanomedicines as an Alternative to Conventional Pharmaceuticals in Treatment of Heroin Use Disorder

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Heroin is a highly addictive opioid drug, and its abuse has consequences detrimental to the whole society as well as the individual user. Heroin works by binding to and stimulating opioid receptors which are embedded in the outer membrane of neurons. Heroin and other opioids mimic the chemical interaction of peptide neurotransmitters, Enkephalins and Endorphins, with Opioid receptors. These neurotransmitters produce pleasurable feelings by alleviating pain and creating a sense of well-being by altering the activity in the limbic system, which controls the reward centre. Repeated consumption of opioids produces changes in Dopamine networks leading to a reinforcement of drug-taking behaviour, leading to addiction.

When people addicted to opioids like heroin try to quit or reduce their abuse, they undergo withdrawal symptoms that prompt them to relapse. Pharmacological treatment can help reduce drug cravings and many physical symptoms that result from quitting opioid use, thus improving the odds of achieving abstinence. Currently, three types of medications are used independently or in several combinations to achieve this purpose: (1) agonists (like Methadone), which activate opioid receptors; (2) partial agonists (like Buprenorphine), which also activate opioid receptors but produce a smaller response; and (3) antagonists (like Naltrexone), which block the receptor and interfere with the rewarding effects of opioids. Nevertheless, these conventional medicinal formulations have their downsides. These drugs mandate heavy financial investment and the need for daily commitment by patients, and thus, a low retention rate. Moreover, many of these formulations confer opioid-like effects in some patients making them merely less-harmful substitutes for hardcore drugs. Presently there is no ideal combination of these drugs that maintains the benefits while bringing down their limitations.

An alternative to these conventional pharmaceutical formulations can be presented by the application of principles and practices of nanotechnology to pharmacology. Conventional pharmaceutical molecules, both natural and synthetic, are usually composed of long organic chains and rings. In addition to the active site which is of clinical significance, there inevitably are other functional groups that either: (1) bind with receptors other than our target receptor and thus produce side effects or (2) interfere with the capability of the active site to bind with the target receptor. With the progress in our understanding of the molecular structure of various Opioid receptors, we can study the chemistry of drug-receptor interaction to formulate *nanomedicine* preparations that diminish the side effects and concurrently amplify the efficiency of drug delivery and uptake.

Nanomedicines prepared using biodegradable and non-toxic nanoparticles of lipids, polymers, or inorganic materials, or combinations thereof, are of particular significance in this case. These nanomedicines should have structures that allow them to interact only with the target receptors to prevent side effects. To further boost efficiency, the non-active molecules in nanomedicines should neither interact with non-target receptors nor interfere with the binding of the active site with the target receptor. Some other factors must also be considered when engineering such nanomedicines: (1) Drug release should not affect the drug action, (2) Elimination of the carrier/ drug residue should be easily facilitated by simple metabolic processes, (3) Drug delivery system should be efficient with minimum in-transit leakage and enhanced uptake by target cells.

The engineering of such nanomedicines is bound to prove helpful in the treatment of Heroin use disorder. Such modern drugs can help reshape the lives of millions of substance abusers and keep in check the growing menace of drug abuse across the world.

The paradigm of molecular Eco-nanotechnology for biocompatibility: *Zebrafish* and *P. Caudatum* as *in vivo* models

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Abstract

The recent decade has seen a multidimensional advancement in material science and nanotechnology towards their application in environmental applications; owing to their peculiar biophysical properties. However, the increasing graph of their utility in different applications has also raised concern to the safety issues to environment and human health. Efforts have been taken to advance the material science technologies however their applicability depends on their compatibility with the ecosystem. Our studies are extensively focused on the investigation of mechanistic biocompatibility of industrial and natural materials to understand the phenomenon at molecular scale using Zebrafish and paramecium models. Zebrafish (*Danio rerio*) has been recognized as one of the best *in vivo* models to explore the ecocompatibility of nanomaterials because of their genetic similarity with human, economic maintenance and short life cycle. Hence, understanding the intrinsic compatibility of nanomaterials with zebrafish provide deep information on their ecocompatibility and provides new opportunities for their functionalization for better applications. Similarly, the use of *P. Caudatum* has been considered as one of the best *in vivo* models to determine ecocompatibility because of their vast availability and noticeable role in food chain of ecosystem. Our studies provide detailed information on molecular interaction of industrial nanomaterials like TiO_2 nanoparticles with Zebrafish and *P. Caudatum* with an evaluation of their molecular impact on physiological and developmental processes. With the help of experimental and computational approach, we have determined the impact of TiO_2 nanoparticles on toxicological effects at molecular level like oxidative stress induction and apoptosis of cells to explain them at deep intrinsic level. Our group is also involved in functionalization of other nanomaterials and their toxicological investigation using biogenic materials like biosurfactant.

Keywords: Zebrafish, Nanomaterials, *P. Caudatum*, Nanotoxicity, Nanoinformatics.

EFFECT OF CRUMB RUBBER-NANOSILICA COMPOSITE ON SOFT GRADE ASPHALT RHEOLOGICAL PROPERTIES

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Keywords: Crumb rubber; Nanosilica; Superpave rutting parameter; Superpave fatigue parameter; Storage stability.

Nanomaterials have been widely used to enhance the physical, rheological and mechanical properties of asphalt binders in recent years. Addition of nano-sized additives improves the performance of asphalt binder and overcomes the drawbacks of polymers. Thus, polymer nanocomposites are considered to be more powerful modifiers. Nanosilica is an inorganic nanomaterial that has been being widely used to enhance the performance of polymer modified asphalt. Addition of Nanosilica improves the storage modulus, elasticity and ageing resistance of asphalt binder because of its high specific surface area, high functional density and high strain resistance. This study aims at investigating the effect of using nanosilica (NS) as a modifier for Crumb rubber (CR) modified asphalt binder. In this study, the concentration of CR was kept constant as 12% (wt of base binder) and the nanosilica concentration was varied from 1%-6% (wt of base binder). The effect of varying concentrations of nanosilica on CR modified binder were evaluated by utilizing various physical tests, rotational viscosity (RV), dynamic shear rheometer (DSR), thin film oven (TFO), pressure aging vessel (PAV) and storage stability test. Results showed that crumb rubber-nanosilica modified bitumen exhibited higher complex modulus (G*) and lower phase angle (δ), indicating an improvement in the stiffness and elasticity. The addition of nanosilica also showed enhancement in rutting performance, Brookfield viscosity and storage stability of CR modified binders.

EFFECT OF SBS-NANOSILICA COMPOSITE ON BITUMEN RHEOLOGICAL PROPERTIES

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Keywords: Styrene Butadiene Styrene; Nanosilica; Superpave rutting parameter; Superpave fatigue parameter; Storage Stability.

To improve the performance of asphalt mixture, it needs to be modified with suitable modifiers. Nowadays, pavement technologist and researchers have put their interests in nanotechnology because of their extraordinarily interesting properties. A defining feature of polymer nanocomposites is that the small size of fillers leads to a dramatic increase in interfacial area as compared to traditional composites. Nanosilica is generally used in the preparation of polymeric nanocomposite blends due to the high reaction between silica material and the asphalt binder that results in higher dispersion ability of nanosilica and polymers within the bitumen blend compared to other nanomaterials. In this paper, the effect of using nano silica as a modifier for SBS modified asphalt binder was studied. The effect of varying concentrations (1%, 1.5%, 2%, 2.5% and 3%) of nano silica on 3% SBS modified binder were evaluated by utilizing various physical tests, rotational viscosity (RV), dynamic Shear Rheometer (DSR), thin film oven (TFO), pressure aging vessel (PAV) and storage stability test. Result showed that Nanosilica-SBS modified bitumen exhibited higher complex modulus (G*) and lower phase angle (δ), indicating an improvement in the stiffness and elasticity. Addition of nano silica also showed enhancement in rutting performance, Brookfield viscosity and storage stability of SBS modified binders.

Synthesis of CuO nanoparticles using maize silk extract, characterization and evaluation of its antibacterial activities

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KEYWORDS: XRD, Monoclinic, NPs, Morphology, Well diffusion, ZOI.

CuO nanoparticles are now a day used to target bacteria as an alternative to antibiotics. CuO nanoparticles were synthesized by sol gel method. The synthesized nanoparticles were characterized by x-ray diffraction (XRD), Fourier transform Infrared (FT-IR) spectroscopy, Scanning electron microscope (SEM) and antimicrobial activities. The XRD verifies that this sample is in wurtzite phase with hexagonal crystal structure. The average crystallite size of CuO nanoparticles is calculated using Scherer equation and is about 40 nm and is well matched with JCPDS card (No. 37-1493). Powder X software was used to determine the lattice parameters. FT-IR shows various characteristics functional group present in the prepared CuO nanoparticles. Further FT-IR confirmed the presence of bioactive functional groups involved in the reduction of copper sulphate to copper oxide nanoparticles. The spectral peaks at 400-600 cm^{-1} proposed the formation of CuO nanoparticles. The morphology of CuO nanoparticles was analyzed by scanning electron microscope. The structure of CuO nanoparticles was found spherical in shape. Plants silk extract mediated CuO nanoparticles showed strong antibacterial activities against both gram positive and gram negative bacteria. Well diffusion method was used to check antibacterial activities against gram positive (Staphylococcus aureus) and gram negative bacteria (Escherichia coli, and Klebsiella pneumonia) under different conditions.

Performance of Crumb Rubber-Nanoalumina Modified Asphalt Binder at High and Moderate Temperatures

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This study's objective is to determine the effects of incorporating nanoalumina (NA) into an asphalt binder that has been changed using crumb rubber (CR). In this study, the amount of nanoalumina was varied from 1% to 6% while the amount of CR was maintained at 12% (weight of base binder) (decided after literature survey). In order to evaluate the effects of various nano alumina concentrations (by weight of binder) at varied concentrations (1%, 2%, 3%, 4%, 5%, and 6%), physical tests such as penetration, softening point, and ductility were used. Using the Rotational Viscosity (RV) and Dynamic Shear Rheometer (DSR) tests, theological characteristics of the base binder and the nano alumina polymer modified asphalt binder were analysed. Also, the effectiveness of modified asphalt following tests in a thin film oven (TFO) for short-term ageing and a pressure ageing vessel (PAV) for long-term ageing was evaluated. The storage stability of the modified asphalt binder was also assessed. The results demonstrated that adding nano alumina improved the anti-rutting properties of CR modified asphalt binders. After the addition of nano alumina, the storage stability of the CR modified asphalt binders dramatically increased. The addition of 4% NA and 12% CR enhances the performance of the binder's rutting strength, according to the Superpave rutting metric (G/ Sin). The fatigue measure also showed a minor rise at a particular proportion of CR and NA.Improvements to the asphalt binder show no phase separation under high temperatures, according to a storage stability test. This suggests that the CR-modified binder's physical properties were successfully improved when a little amount of NA was introduced. As the amount of nano alumina was increased, it was discovered by rheological characterization that the complex modulus, phase angle, Superpave Rutting parameter, and failure temperature all increased. Furthermore, it was discovered that as the binder stiffens, Brookfield viscosity rises with the concentration of nano alumina. All test findings supported the assertion that the crumb rubber-Nanoalumina modifier is efficient in enhancing the high temperature qualities (rutting resistance) of the soft grade binders while also increasing the elasticity.

Keywords: Crumb Rubber, Nanoalumina, Superpave Rutting Parameter, Superpave Fatigue Parameter, Viscosity, Ageing, Storage Stability

Unveiling Extraordinary Magnetoelectric Coupling in Room Temperature Z-Type Hexaferrite Films

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Keywords: Multiferroic materials, magnetoelectric coupling, Z-type hexaferrite thin films, magnetoelectric devices.

In this talk, we explore the fascinating realm of multiferroics and their extraordinary magnetoelectric (ME) coupling in thin films. This intriguing phenomenon, which involves the simultaneous presence and coupling of electric and magnetic orders, holds great promise for applications in spintronic devices and provides insights into spin-lattice coupling. Researchers have proposed diverse mechanisms to enhance ME coupling in both single-phase and composite multiferroics, resulting in the continuous discovery of novel materials and structures. Addressing the challenge of achieving strong ME effects in thin films of hexaferrites, typically observed in bulk materials near room temperature, we present a study on the magnetoelectric coupling of epitaxial thin films of Co_2Z-type hexaferrite $Ba_{0.3}Sr_{2.7}Co_2Fe_{24}O_{41}$ (BSCFO) grown on a $SrTiO_3$ (111) substrate. Quantitative analysis reveals that the ME susceptibility and modulated electric polarization (ΔP) induced by a magnetic field in the BSCFO films consistently exceed those of the Co2Z-type single crystal by approximately 2-15 times, with further enhancements observed as the q_x broadening in the (0014) and (0018) peaks increase. Notably, the off-centered octahedral sites, primarily contributing to ΔP through the p-d hybridization mechanism, demonstrate that the orientational disorder can further enhance effective off-cantering. These findings, combined with the observation of the four-bit memory effect in the P versus H curves, highlight the potential of ME hexaferrite films for multifunctional device applications, paving the way for next-generation nano-electronic devices and multibit nano-memories.

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Modulation of native structural architecture and functional properties of apple seed protein isolates by planetary ball milling treatment

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In this study, protein isolates extracted from apple seeds were subjected to planetary ball milling (PBM) and investigated for structural, morphological, thermal and functional properties. Results revealed that PBM led to production of protein nanoparticles having hydrodynamic diameter of 490.21 nm. Disorientation in protein microstructure could be observed by SEM whereas; SDS-PAGE indicated no significant degradation of main subunits. Meanwhile, PBM remarkably increased random coil and β-turn composition as evident from FTIR and CD spectra. Owing to conformational changes, a notable increase in surface hydrophobicity was observed in apple seed protein nanoparticles (APN). A decline in crystallinity in APN was found due to partial denaturation caused by PBM treatment. PBM treatment was found effective in improving the protein solubility and emulsifying properties. Besides, Confocal laser scanning microscopy (CLSM) revealed that emulsions prepared with APN showed increased stability, probably by inhibiting flocculation and coalescence of oil droplets. The results demonstrated not only the strong feasibility of ball milling process for successful synthesis of protein nanoparticles with excellent structural and functional

properties but also provide new insights into application of APN in fabrication of stable emulsion-based functional foods.

Keywords: Apple seed protein; Nanoparticles; Structural characterization; Functional properties; Emulsion stability.

UP SCALING THE UTILISATION OF MILLETS BY DEVELOPING FUNCTIONAL COOKIES FORTIFIED WITH QUERCETIN STARCH NANOCAPSULES.

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The current study was undertaken to develop buck wheat flour based functional cookies fortified with quercetin nanaoencapsulated in sorghum (SSQ), pearl millet (PSQ) and foxtail millet (FSQ) starch particles. The starch nanoparticles were prepared by acid hydrolysis method followed by quercetin nano encapsulation by ultrasonication approach. Characteristic properties of nano capsules were evalvated by particle size analysis using DLS, morphological analysis using SEM and AFM. Encapsulation efficiency was also evaluated which was found to be the range of 55-65%. Buck wheat flour based functional cookies were then developed by the addition of quercetin-starch nanocapsules. The quercetin content was well retained in the developed cookies. Characteristic properties like neutraceutical potential, textural and sensory attributes were evaluated for a storage period of 0-6 months. The extruded snacks showed good anti-oxidant (Lipid peroxidation activity) and cholestrase inhibition activity. The overall acceptability of the functional cookies was found to be equal on a 9-point hedonic scale.

Keywords Quercetin; nano starch; millets; functional cookies; nutraceutical.

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NUTRACEUTICAL AND TOXICOLOGICAL EVALUATION OF HYDROGELS ARCHITECTED USING RESISTANT STARCH NANOPARTICLES AND GUM ACACIA FOR CONTROLLED RELEASE OF KAEMPFEROL

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Resistant starch nanoparticles (RSN) were obtained using ultrasonication. RSN displayed a hydrodynamic diameter of 345.12±0.01 nm and zeta potential of 16.78±0.04 mV. A bio composite hydrogel (RSNG) was formed by incorporating RSN of varying concentration (0.2, 0.4 and 0.8%) in gum acacia (GA) to form resistant starch nanoparticle - gum acacia hydrogel, RSNG (0.2), RSNG (0.4) and RSNG (0.8), respectively. Kaempferol was nano encapsulated in RSNG (0.2, 0.4 and 0.8%) for its controlled release. RSNG (0.4) displayed highest encapsulation efficiency of 61.23±0.56% and in vitro release of kaempferol followed Higuchi model. Toxicity evaluation of RSN and RSNG revealed no effect on calf thymus DNA and human embryonic kidney (HEK-293T) cells. The nutraceutical potential of RSNG

showed retention of anti-oxidant, anti-diabetic, anti-hypertensive, anti-lipidemic and anti-microbial properties in simulated gastro-intestinal conditions (SGID). RSNG can efficiently encapsulate flavonoids and retain bioactivity in human digestive conditions that can be applied in food and pharmaceutical areas.

Keywords: Kaempferol; hydrogel; controlled release; toxicity.

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PICKERING EMULSIONS STABILIZED BY STARCH NANOPARTICLES AS A DELIVERY VEHICLE FOR SHIKONIN

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In the present study, starch nanoparticles from lotus stem (SNL), horse chesnut (SNH) and rice (SNR) were obtained using ultrasonication. Dynamic light scattering revealed a hydrodynamic diameter of 368.09, 432.01 and 422.09 nm and a zeta potential of -18.09, -22.78 and -21.07 mV for SNL, SNH and SNR, respectively. Starch nanoparticles were then used to stabilize flax seed-oil water mixture to form pickering emulsions (PE). The emulsions were used to nanoencapsulate shikonin – a well known bioactive via ultrasonication. The emulsions were characterized using dynamic light scattering (DLS), light microscopy,

scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy (AFM) and attenuated total reflectance fourier transform infra-spectroscopy (ATR-FTIR). AFM showed shikonin –PE as spherical droplets embedded in the matrix with maximum peak height of 8.47 nm and maximum pit height of 1.69 nm. SEM presented shikonin-PE as an irregular and continuous surface having multiple folds and holes. The ATR-FTIR spectra of all the samples displayedstretching vibrations in a region of 3670–3150 cm1, overlapped bands from C-H stretching vibrations at 2923 cm^{-1}, band which belonged to stretching vibration of ester carbonyl group at 1745 cm^{-1} , band from H-OH bending vibrations at 1614 cm^{-1}, signifying successful encapsulation. In vitro release assay displayed more controlled release of shikonn from SNL stabilized PE. Bioactivity of PE was evaluated in terms of anti-cancer, anti-diabetic, angiotensin converting enzyme (ACE) inhibition and prevention against oxidative damage under simulated gastro-intestinal conditions (SGID). The bioactivity of SNL was significantly higher than SNH and SNR. Key findings reveal that Pickering emulsions can prevent shikonin under harsh SGID conditions and provide an approach to facilitate the design of Pickering emulsions with high stability for nutraceutical delivery in food and supplement products.

Keywords: Shikonin; starch nanoparticles; controlled release; Emulsions.

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B-GLUCAN AS HOST FOR SUSTAINABLE DELIVERY OF QUERCETIN INTO EXTRUDED SNACKS PREPARED USING BARLEY FROM HIMALYAN TERRAN

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In this work, nanoencapsulated quercetin capsules were prepared from β-glucan (barley and oats) and added with barley flour (0.5% w/v) for the preparation of a functional extruded snack. The functional extruded snacks were evaluated for their physical and nutraceutical properties. The encapsulation efficiency of the snacks was found in the range from 8 to 55 % respectively. Results revealed an increase in porosity and hardness followed by a decrease in the expansion ratio of the functional extruded snacks. FTIR results showed changes in the molecular spectra and the presence of new peaks of quercetin in the functional snacks. Furthermore, enhanced antioxidant, antidiabetic, antiobesity activity was found in the functional snacks in comparison to control and free quercetin. The functional extruded snacks showed good sensorial acceptability and offer a good nutraceutical contribution.

Keywords: β-glucan; functional extruded snacks; antidiabetic; antioxidant; antiobesity.

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Exploitation of novel plant-based protein a step towards sustainable food system; its structural and functional characterisation

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There are various alternate protein sources, among which pulse proteins stand out for functional properties and their nutritive values together with sustainability. At the moment, global attention is focused on soy and pea proteins, ignoring other pulses. As a result, this study was carried out to analyse underexplored pulses such as broad bean protein (BBP), mung bean protein (MBP), and lentil bean protein (LBP). Samples (BBP, MBP and LBP) were characterized for charge, protein pattern, amino acid profile, secondary structure, crystallinity, thermal and functional properties. Results revealed that the charge of the BBP, LBP and MBP varied in the range of -38.7 to -45.5 mV. Circular dichroism, FTIR and X-ray diffraction revealed secondary structure, and conformational characteristics. SEM showed octahedron structure with groves and ridges for BBP and crystalline structure for MBP and LBP. DSC showed higher stability of BBP and MBP in comparison of LBP. SDS-PAGE depicted presence of 7S-vicilin and 11S-legumin proteins. Amino acid profiling revealed good content of essential amino acids in BBP and MBP in comparison of LBP. However, BBP and MBP exhibited good functional properties such as emulsifying, foaming, oil and water absorption capacity in comparison to LBP can be used as a protein alternative to design the next generation plant-based meat and dairy alternatives.

Keywords: Alternate protein; amino acid analysis; circular dichroism; functional properties.

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Upscaling of apple by-product by utilising apple seed protein as a novel wall material for encapsulation of chlorogenic acid as model bioactive compound

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Encapsulation is the versatile technique used to protect the sensitive bioactive compounds under gastrointestinal conditions. So, in this study, nanoencapsulation of chlorogenic acid into the apple seeds protein matrix was done using green technique ie, utrasonication to protect it from harsh gastric conditions and increase its biological activity and bioavailability upon digestion. Both nano (Nano-Chl) and native capsules (NT-Chl) were characterised for particle size, charge, structural and morphological properties. The encapsulation efficiency, release behaviour, antioxidant and antidiabetic properties were also evaluated. The experimental results showed that the particle size of the NT-Chl and Nano-Chl was found in the range of 1.4 µm to 708 nm. The encapsulation efficiency was found to be 69% & 80% for NT-Chl and Nano-Chl. Furthermore, *in vitro* digestion study revealed that Nano-Chl showed controlled release behaviour under simulated intestinal conditions in comparison to NT-Chl. Moreover, Nano-Chl showed enhanced antioxidant and antidiabetic activity in

comparison to NT-Chl after digestion. It was concluded that the protein from apple seed can be utilised as a functional ingredient itself or as a wall material for encapsulation of sensitive bioactive compounds. Further, these encapsulated particles can be fortified into different food formulations for the development of functional food.

Keywords: Naoencapsulation; protein; chlorogenic acid; release behaviour; antidiabetic; antioxidant.

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Design, Synthesis, Molecular Docking and Antifungal Activity of Triazole Derivatives of Piperic Acid

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A library of triazoles (PAt1-12) was prepared from piperic acid [(2E, 4E)-5-(2H-1,3-Benzodioxol-5-yl)penta-2,4-dienoic acid] on treatment with proporgyl bromide followed by azides under prescribed reaction conditions. Piperic acid was obtained by hydrolysis of piperine, extracted from *Piper nigrum*. All synthesized compounds were fully characterized by FT-IR, ^{1}H NMR and ^{13}C NMR spectroscopy. Molecular Docking studies were carried out using AutoDock-vina software. Antifungal activity of triazole derivatives, using Poison Food Technique (PFT) was carried out against the fungal species; *Fusarium*, *Penicillium* and *Aspergillus*. The maximum mycelial growth inhibition percentage in *Penicillium* and *Aspergillus* species was observed by PAt2 and in *Fusarium* species, by PAt11.

Key words: Piper nigrum, Piperic acid, Triazol.es, Molecular Dockin

NBL -2023 Summit @ NIT Srinagar

Program at a Glance of NBL FROM: 25th – 29th May 2023

Day 1, Friday, 25th May 2023

(Modified Version)

Time	Day 1, Thursday, 25th May 2023 SKUAST-Kashmir
09:00 am onwards	REGISTRATION: PLEASE REGISTER- Team headed by Prof Hamida Auditorium – Nundrishi Hall (SKUAST Kashmir) Prof Gausia Qazi & Prof S Rubab
09:00 – 09:30	Inauguration of Pre-Conference Symposium by Hon'ble Guests

Students from Schools, Colleges, and Hon'ble Guests of School /College Education ~250 Local Industry Students Interaction Session		
Mr. Khurshid, Miss Saba & Miss Sana on stage		
Time	Name & Affiliation	Title of the talk
09:15 -09:30	Prof. M.S. Mir	Brief inaugural address
09:30- 10:30	Prof Pushkin Kachroo, Ph.D Lincy Professor, University of Nevada, Las Vegas	Dimensions and Topology: Fractal to Infinite
10:30- 11:00	Prof. Yoshiro AZUMA Ph.D Sophia University, Tokyo, Japan	Big Jump from Japan to IIT Delhi
11:00-11:30	Prof D D Sarma Distinguished Professor, IISc Bangalore	Interaction with Valley Students
11:30-12:00	Prof (Dr.) Ahmad Faud Dean, University of Uni KL, Malaysia	Biomedical applications for nanomaterials
12:10-12:30	Prof Dzul Honourable Rector International Islamic University Malaysia	Human governance and sustainability (Online)
12:30:12:35	Conclusion of Symposium Session by	Prof. M.S. Mir
Essay Competition/Quiz/Feedback I/C : Dr. Nadeem & Dr Sajad Ahmad Mir		
12.45 Lunch Break for Students & (District Wise Photo Graph) Departure to Botanical Garden, Nishat Srinagar (Accompanied by Experts) (Not confirmed)		
12:45 – 01:45	**Lunch Break for participants & Delegates in their respective counters**	
01:55 – 4:00	Inauguration of 5 days Int Conference NBL – 23 @ SKUAST –K Minute to Minute Programme to be Issued and uploaded	
4:00-4:30	Evening Tea	
4:30 –05:00	Keynote Talk by Prof. D.D. Sarma, IISc Bangalore	Chair: Prof Ahmad Faud The University of Uni KL

	Q/A Session with remarks	
05:00 – 05:30	Prof. Ahmad Faud, University Kuala Lumpur, Malaysia	Chair: Prof Amit Ganatra Parul University
05:30 – 07:30	Departure to Hotels & Guest Houses (List of respective places uploaded) Buses shall be near Venue: I/C Transport	

Day 2, Friday, 26th May 2023

(Modified Version)

Time	**Agri-Nanotechnology and Allied subjects** **Coordinators: Dr. M Z Ansari & Dr. Tariq A Sofi**
Session-I	**Session Chair**: Dr Shaheen K Jan, Prof & Head, Division of Plant Pathology, SKUAST-Kashmir **Co-Chair 1**: Dr M D Shah, Head RCRQA, SKUAST-Kashmir **Co-Chair 2**: Dr M A Bhat, Division of Plant Pathology, SKUAST-Kashmir
09:15 – 9:35	Prof. Pushkin Kachroo, University of Nevada, Las Vegas (**Keynote Address**)
9:35 – 9:55	Dr Alka Sharma, University of Rajasthan, Jaipur, India **(Invited Lecture)**
9:55 – 11:15	Oral Presentations (**10 No**.) : 8 Minutes Each **Oral Presentation Evaluation Committee**: Dr Javid Ahmad Banday (Prof NIT), Dr Tariq Rasool Rather, Dr Gowhar Ali
Oral Presentations	1) Prof. Sumit Saxena, IIT Bombay 2) Sara Dua, JMI, New Delhi 3) Faiza Jhan, University of Kashmir 4) Jasmeen Kaur, LPU, Punjab 5) Riya Tandel, NIT, Surat 6) Shubhangi Pandey, University of Baroda, Vadodara, Gujrat 7) Farhana Hussain, University of Science and Technology, Meghalaya 8) Nitish Priyadarshi, National Agri Food Biotechnology Institute, Mohali 9) Prof. Unnati A Joshi, Parul University 10) Prof. D.M. Kulkerni, BITS Goa
11:15 – 11:45	TEA BREAK and (First Group poster Presentation: 1-50) **Poster Presentation Evaluation Committee**: Dr M D Shah, Dr Jigneshkumar V Rohit (NIT), Dr Aflaq Hamid
Session-II	**Session Chair**: Prof. Imtiyaz Murtaza, SKUAST-Kashmir **Co-Chair 1**: Dr B A Padder, Division of Plant Pathology, SKUAST-Kashmir **Co-Chair 2**: Dr Sabiya Bashir, Division of Plant Pathology, SKUAST-Kashmir
11:45- 12:05	Dr. Shafeer Kalathil, Northumbria University, Newcastle, UK (**Keynote Address**)
12:05 – 12:25	Prof. Sajad Ahmad Loan, Jamia Millia Islamia, New Delhi **(Invited Lecture)**
	Oral Presentation Evaluation Committee: Dr Amatul Muhee, Dr Shamimah Hussain (UGC-DAE Kalpakkam), Dr Parvaiz Ahmad Sheikh
12:25 – 13:00	Oral Presentations (4 No.) : 8 Minutes Each 1) Prof. D.M. Kulkerni, BITS Goa 2) Prof. Sumit Saxena, IIT Bombay 3) Dr. C.N. Tharamani, IIT Ropar 4) Dr. Rajesh Kumar, BITS Pilani
13:00 - 14:15	LUNCH BREAK & (2nd Group poster Presentation: 51-100) **Poster Presentation Evaluation Committee**: Dr Sajad Mohamad Wani, Dr Saba Banday, Dr Faheem Arjamand (KU)
14:15 – 15:05	Oral Presentations (6 No.) : 8 Minutes Each
Oral Presentations	5) Dr. P.C. Pandey, IIT BHU 6) Dr. Manoj Kumar, IIT BHU 7) Shahnaz Anjum, SKUAST-K & LPU 8) Dr. Indra Sulania, IUAC New Delhi 9) Dr. S.N. Patel, BITS Pilani 10) Dr. Kiran D Mali, BITS Gao
Session-III	**Session Chair**: Prof. M S Pukhta, SKUAST-Kashmir **Co-Chair 1**: Dr Z A Bhat, Division of Plant Pathology, SKUAST-Kashmir **Co-Chair 2**: Dr Najeeb Mughal, Division of Plant Pathology, SKUAST-Kashmir

15:15 – 15:35	Prof. Shobha Shukla, IIT Bombay (**Keynote Address**)
15:35 – 15:55	Prof. Amatul Muhee, SKUAST-Kashmir **(Invited Lecture)**
15:55 – 17:15	Oral Presentations (10 No.) : 8 Minutes Each **Oral Presentation Evaluation Committee:** Prof Unnati A Joshi (Parul University), Prof P A Ganie (NIT-Srinagar), Dr B A Padder
Oral Presentations	1) Dr. Vikas Chaudhuri, BITS Goa 2) Dr. G Kartikeyan, KCUT 3) Dr. Awaneesh Singh, IIT (BHU) 4) Dr. Shilpi Chaudhary, PEC Chandigarh 5) Dr S N Panday, MNIT Allabad 6) Arifa Gulzar, SKUAST-K 7) Dr Deshdeep Sahdev , IIT Kanpur 8) Dr. Manoj Mude, JNU 9) Dr. Sangita Roy, INST Mohali 10) Dr. Sudip Mukherjee, (BHU)
	Certificate Distribution by the Chairpersons and Coordinators
17:15 – 17:30	**Dr T A Sofi, SKUAST-Kashmir (Invited Lecture)**
	Concluded by Dr Tariq Ahmad Sofi

Time	**Day 2, Friday, 26th May 2023** Old	
SKUAST- K	Session Chair: Prof N A Sheikh	
09:15 – 9:40	Prof. Pushkin Kachroo, University of Nevada, Las Vegas	
09:40 - 10:05	Prof. Sandip Chatterjee, IIT (BHU)	
10:05 - 10:30	Dr. Shafeer Kalathil, Northumbria University, Newcastle, UK	
10:30 - 10:45	Prof. Shobha Shukla, IIT Bombay	
10:45 – 11:00	TEA BREAK and GROUP PHOTO (First Group poster mounting 1-84)	
	Two Sessions	
Chairing	Session Chair: Prof. P A Ganaie/Prof Kowsar Majid	Session Chair: Prof Sandip Chatterjee/ Prof J A Bhat
11:00 - 11:20	Prof. Unnati A Joshi, Parul University	Dr. Anand Joshi, Gujarat
11:20 - 11:40	Prof. D.M. Kulkerni, BITS Goa	Prof. P. Pramanik, IIT Kharagpur
11:40 - 12:00	Prof. Sumit Saxena, IIT Bombay	Dr. Indra Sulania, IUAC New Delhi
12:00 - 12:20	Dr. C.N. Tharamani, IIT Ropar	Prof. Sudipto Chakravorty, IIT Kharagpur
12:20 - 12:40	Dr. Joyee Ghosh, IIT Delhi	Prof. Krishna Kumar Singh, BITS Dubai
12:40 - 13:00	Dr. Rajesh Kumar, BITS Pilani	Dr. S.N. Patel, BITS Pilani
13:00 - 13:20	Dr. P.C. Pandey, IIT BHU	Dr. Kiran D Mali, BITS Gao
13:20 - 13:40	Dr. Manoj Kumar, IIT BHU	Dr. Vikas Chaudhuri, BITS Goa
	Certificate Distribution by the Chairpersons and Coordinators	
13:40 - 14:20	LUNCH BREAK	
	Chair: Prof. Rajendra Prasad	Chair: Dr. Unnati Joshi/ Prof Shobha Shukla
14:20 - 14:40	Dr. G Kartikeyan, KCUT	Dr. Manoj Mude, JNU
14:40 - 15:00	Dr. Awaneesh Singh, IIT (BHU)	Dr. Sangita Roy, INST Mohali
15:00 - 15:20	Dr. Shilpi Chaudhary, PEC Chandigarh	Dr. Sudip Mukherjee, IIT (BHU)
15:20 - 15:40	Dr. S N Panday, MNIT Allahabad	Dr. Alakh N. Sahu, IIT (BHU)
15:40 - 16:00	Dr Deshdeep Sahdev, IIT Kanpur	Dr. Altaf Ahmad Bhat, CIRI, KU

16:00 - 16:20	TEA BREAK and GROUP PHOTO (Second Group poster mounting)	
	Chair: Prof. Yoshiro Azuma/ Prof B A Mir	Session Chair: Prof. K K Singh/ Dr. Saifulla
16:20 - 16:40	Prof. Sanjay Kr. Srivastava, BHU	Dr. Amiya Ranjan Sahoo, VNIT, Nagpur
16:40 - 17:00	Dr. Sunita Srivastava, IIT Bombay	Dr. Sandeep Singh, IIT Indore
17:00 - 17:20	Dr. Devender Tayal, IG Technical University	Dr. Fouzia Khan
POSTER SESSION OF 1- 75 (Shall be evaluated by Jury) Certificate Distribution by the Chairpersons and Coordinators		

Day 3, Saturday, 27th May 2023

Time	Day 3, Saturday, 27th May 2023 (NIT Srinagar) Dr. Vijay Kumar & Prof. S Rubab (Women's Session)	
	Session Chair: Prof S. Rubab and Prof. Tharamani	
9:00 – 9:20	Prof. Venu Gopal, Director, NPL	
9:20 - 9:40	Prof. Alka Sharma, Univ of Rajasthan	
9:40 - 10:00	Prof. Yoshiro Azuma, Sophia University Tokyo	
10:00 - 10:20	Dr Aghaa Shahee, University of Kashmir	
10:20-10:50	Prof. Mrutyunjay Saur, KIIT Bhubaneswar	
10:50 – 11:00	TEA BREAK and GROUP PHOTO (Second Group poster mounting 85-179) Two Sessions	
	Session Chair: Prof. Alka / Prof Shugufta	Session Chair: Prof. M A Rather/Dr. M Ahsan Chasti
11:00 - 11:15	Dr. Ruchi Srivastava, Parul University	Dr. Suriya Rehman, KSA
11:15 - 11:30	Dr. Pratima Gupta, NIT Raipur	Dr. Rajeev Singh, IIT (BHU)
11:30- 11:45	Dr. Shahnaz Majeed, UKL, Malaysia	Dr. M Shaharyar Wani, Princeton
11:45 - 12:00	Dr. Manju, Punjabi University	Dr. Arif Gulzar, Queensland University
12:00 - 12:15	Dr. Amita Jain, NSUT, New Delhi	Dr. Arun Jaiswal
12:15 - 12:30	Dr. Lakshmi GVBS, JNU, New Delhi	Dr. Yogendra Kumar
12:30 - 12:45	Dr. Soumya Saswati Sarangi, VSSUT	Dr. Chandrashekhar Bhat
12:45 - 13:00	Dr. Divya N Shetty, St Aloysius Coll	Dr. Nila Pal
13:00 - 13:15	Dr. Sanchita Roy, Royal Global Uni	Dr. Nitesh Priyadarshi
13:15 - 13:30	Dr. Debjani Bagchi, UoB	Dr. Shruti Sharma
13:30 - 13:45	Dr. Rosy Mallik, CUTM, Odisha	Dr. Awadesh Kumar

13:45 - 14:30	LUNCH BREAK:		
14:30 - 14:45	Mrs. Priyankaa Varghese, Dean FCRI		
14:45 - 15:00	Dr. N.K. Srivastava, NIT Jalandhar		
15:00 - 15:15	Dr. Bishnu P. Biswal, NISER B		
15:15-15:30	Dr. Saima Naz, UoH		
	Chair: Dr. Suriya Rehman/ Prof Tabasum	Session Chair: Dr. Indra / Dr Suman	
15:30 - 15:45	Dr. Prem Lata, NIT Surat	Dr. Nidhi Sinha, University of Delhi	
15:45 - 16:00	Dr. Gulzar Bhat, CIRI KU	Dr. Muzaffar Boda, Shanghai	
16:00- 16:15	Dr. Khalid Sultan, CU Srinagar	Dr. N. R. Jana, IACS Kolkata	
16:15 - 16:30	Dr. Murthy Dharmapura, MIT	Dr. Ashish Rajak IIT Indore	
16:30 - 16:50	TEA BREAK and GROUP PHOTO		
	Session Chair: Prof. Ashok / Dr. M Mursaleen	Oral Student Session: Chair: Prof. Khasa/ Prof Tinku	
16:50 – 17:00	Dr. Mudasir Ahmad, South Dakota	Sourav Sen	Kaustubh Naik
17:00 – 17:10	Dr. Javid Yousuf, CIRI KU	Tejas Suryawanshi	Nivedhitha T R
17:10 - 17:20	Dr. Veerababu, IGCAR	Tawseef Ahmad	Sakshi Gumber
17:20 - 17:30	Dr. Pallavi Singhal, BARC, Mumbai	ISHA BHASIN	Priya Sharma
17:30 - 17:40	Dr. Ravindran, UNIKL, Malaysia	Gaurav Singh	Waseem UL Haq
17:40 - 17:50	Dr Siddique , BHEL	Shubham Garg	Nuha Abeer Khan
17:50 - 18:00	Dr. Ramprakash, SMVDU, Katra	REENA SAJWAN	Joyti, Maharastra
18:00 - 18:10	Dr Sangita Roy	Daisy Mehta	Jyotsana Mishra
18:10 - 18:20		Mr. Nithesh Kumar	Swamma Singh
POSTER SESSION OF 180 - 273 (Shall be evaluated by Jury) Certificate Distribution by the Chairpersons and Coordinators			

Day 4, Sunday, 28th May 2023

Time	Day 4, Sunday, 28th May 2023 (NIT Srinagar) Dr. Nadeem & Prof. M Ikram	
	Chair: Prof. Hamida Chasti	Chair: Prof. Gausia Qazi/ Dr. Zamrooda
9:00 – 9:20	Prof. Satish Khasa, DCRUST	Prof. Sajad A. Loan, Jamia Millia Islamia
9:20 - 9:40	Prof. Ashok, DCRUST	Prof. Binay Kumar, University of Delhi
9:40- 10:00	Dr. Mahindra Singh Ra, Parul University	Dr. K Ganeshan, Muthayammal College of A
10:00 – 10:20	Dr. Syed Arshad, Tripura University	Prof. Vasundhara Singh, PEC Chandigarh
10:20 -10: 40	Dr. Saiffulah Lone, NIT S	Dr. Aneesha Acharya K , Manipal Institute
10:40 – 11:00	TEA BREAK and GROUP PHOTO (Third Group poster mounting 151-250)	
	Chair: Prof. Altaf Bhat/ Prof Ashok Bera	Chair: Dr. Tariq Maqbool/ Dr. Tariq A Sofi
11:00 - 11:20	Prof. Tinku Basu, Amity University	Syed Azfarul Haq
11:20 - 11:40	Prof. B F Jogi, Dr. Babasaheb University	Dr. A.K. Shukla, Amity University
11:40 - 12:00	Dr. Sonakshi Vij, VIPS	Dr. Debabrata Patra, INST Mohali
12:00 - 12:20	Dr. Vishnu M, AJCEK, Kerala	Dr. Ashish Rajak, IIT Indore
12:20 - 12:40	Dr. Alok Pandey, IAR, Gandhinagar	Dr. Harsha P. Uskaikar, PES's RSN Goa
12:40 - 13:00	Dr. Manohar Singh, Rajdhani College,	Dr. Yogiraj Dama, Dr Babasaheb University
13:00 - 13:20	Dr. Ashok Bera, IIT Jammu	Prof. SN Pandey, MNNIT

13:20 – 13:40	Dr. Manoj Munde, JNU	Dr. G. Karthikeyan, Kumarguru College
13:40 - 14:20	LUNCH BREAK	
	Chair: Prof. Sajad A Lone/ Dr. Noor	Chair: Prof. Binay Kumar/ Dr Ruchi
14:20 -14:40	Dr. Asima Shah, KU	Dr. Prabal Pratab Singh, GLA University
14:40 - 15:00	Dr. Suman Rani, LPU, Jalandhar	Dr. Nazrul Islam Khan, Neta Subhas Uni
15:00 - 15:20	Dr. Susmita Pramanik, GLA University	Dr. Nooruddin Khan, Hyderabad
15:20 – 15:40	Dr. Satyanaryan Dhal, Centurion	Dr. Shuvendu Narayan Patel, BITS Pillani
15:40 –16:00	Dr. Krishnamorthi G, MCAR Tamil Nadu	Dr. Noor Jahan, CU Himachal
16:00 – 16:20	Dr. Tariq Maqbool KU	Dr. Abida, GDCW Anantnag
16:20 -16:40	Dr. Ravi Vidule, Maharashtra	Mr Khurshid Ahmad
Time	Day 5, Monday, 29th May 2023 (NIT Srinagar) Dr. Avanish Singh & Prof Gausia Qazi, Chairperson Library **Panel Discussion Host: Dr Dinesh Kumar Rajendran**	
09:30-10:00	**Prof Mir Faizal,** Scientific Director Canadian Quantum Research Centre	Panel Discussion on Entrepreneurship in Kashmir present and future trends
10:30-11:00	Dr. Saad Parvez, Head IIEDC, NIT Srinagar	
	Er. Saheel Alaqband AD, MSME (J&K)	
	Dr. Saifullah Lone Scientist D NIT Srinagar	
	Interaction with Innovators & Industry Persons	
11:30 – 12:30	VALEDICTORY FUNCTION AND AWARD CEREMONY	
12:30 - 01:00	**LUNCH & DEPARTURE**	

Prof M A Shah Chair/ HoD Physics

World Meets at NIT Srinagar for NBL -2023 under G 20

International Conference on

"Nanotechnology for Better Living"

NBL-2023 From: 25-29 May 2023

National Institute of Technology Srinagar

Scientists and engineers are finding ways to deliberately make materials at nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, larger surface area, increased control of light spectrum and greater chemical reactivity than their

larger-scale counterparts. Viruses (for instance, COVID-19 and DNA) represent the natural objects on the nanoscale. This new technology (nanotechnology) has found powerful applications in critical areas—including renewable energy for a sustainable environment, crafting nano-wearable devices for health monitoring applications, smart electronic gadgets and a revolution in agriculture and food sciences. More so, this technology is valuable for targeted drug delivery, biosensors, fertilizers and fixing climate change directly/or indirectly. In short, aiming good life without nanotechnology in contemporary times—is impractical and improbable. It has already made a beachhead in the world's economy.

Hon'ble LG of Jammu and Kashmir Shri Manoj Sinha has launched nano-fertilizer, which is expected to bring green revolution in agriculture sector. In the interest of the country, this technology transfer has been done by the company (IFFCO) without any royalty. J & K was the first to launch the product, which has been covered by the media meticulously, with manifold benefits. Many ccompanies are developing nano-materials that will make a difference not only in the taste of food, but also in food safety, and the health benefits that food delivers), fuel cells (it is being used to reduce the cost of catalysts used in fuel cells to produce hydrogen ions from fuel such as methanol and to improve the efficiency of membranes used in fuel cells to separate hydrogen ions from other gases such as oxygen), solar cells (companies have developed nanotech solar cells that can be manufactured at significantly lower cost than conventional solar cells), batteries (companies are currently developing batteries using nano-materials. One such battery will be a good as new after sitting on the shelf for decades. Another battery can be recharged significantly faster than conventional batteries), space (it may hold the key to making space-flight more practical), bring a new revolution in space science.

This new area of science is still in its infancy and there are significant challenges which need to be addressed for the benefit of humanity. This is the main driving force for organizing scientific events on this emerging area of science in this part of the country. The International Conference on **Nanotechnology for Better Living** (NBL) is being organized after every two years with a unique aim to provide a platform for the young scientists for stimulating deliberations which may culminate into collaborative research atmosphere mutually beneficial to all of us. These collaborations in turn will boost not only economic strength but also prosperity of the society. Every time we are making our best efforts to bring together eminent scientists, researchers, academicians and policy makers from across globe to exchange ideas, advance knowledge and discuss key issues on nanotechnology.

The 8th edition of hybrid NBL-23 is being organized in collaboration with IIT BHU and in association with Parual University, Gujarat, SKUAST, K, University of Kashmir, SSM College of Engineering, Department of Education under the aegis of Materials Research Society of India (MRSI). A group of school and college children shall take part in the inaugural function. Thus, dedicated sessions, "Nurturing young minds for a better world" shall be conducted during the conclave, thus handing over this multidisciplinary science to our young and smart generation. A galaxy of local innovators and entrepreneurs shall be the part of the summit, along with our own students. For them we have instituted many awards. It is pertinent to mention that the event is being organized in the backdrop of NBL series, which were marvelous and memorable joint event between IIT Kanpur/IIT Kharagpur under the Co-chair and mentorship of Prof. Kamal K Kar and Prof Pallab Banerji, which were subsequently supported and carried forward by the visionary administration of NIT Srinagar. It has patronship and partnership of many legendaries and prestigious organizations.

The motivation behind the conference is to train young scientists in advance and innovative research methodologies, encourage high-quality interdisciplinary research across departments, that effectively promote scientific research of the institute, bridging J &K natural resources with research and industry for a sustainable scientific culture that can guide to construct a progressive culture for research and development (R&D). We have plenty of local natural resources such as medicinal plants, flowers precious minerals and products which needs to be researched for boosting the local economy and generating unconventional jobs for the betterment of common man. Backed by rationally, we expect the subject of nanoscience could be applied to local products; hence raising the living standards of the people of the state, beside accomplishing the novel goal of research for academicians of their discipline. It is going to pave the way for a revolution in a materials, information and communication technology, medicine and genetics and so on as it starts leaving laboratories and conquer new markets. It will foster the developments of collaboration and associations that will persist for decades and institutional networks that will extend help to advance the understanding of sub theme, "Nanomaterials for Energy, Environment and Electronics". A fabulous fusion of biological, chemical, physical, agricultural and health sciences is expected to provide a vibrant platform to present and discuss path breaking research ideas in nanotechnologies and shall be an interface between academia and industries.

The author teaching and preaching nanotechnology has been also a founding member of NBL series can be reached through mail shahji@nitsri.ac.in for comments and suggestions.

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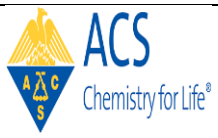

Good Education Makes Better World