Abstracts for Oral Presentations

02001 Transforming agriculture waste into biodegradable packaging: A sustainable and eco-friendly alternative to conventional petroleum-based packaging

Zoraiz Arshad, Muhammad Bilal Khan Niazi, Waheed Miran

The main purpose of this research work is to develop an innovative solution that replaces petroleum-based packaging with a biodegradable one. The study involves to find a solution that caters the environmental and health problems associated with petroleum based packaging. The study also focuses on effective utilization of agriculture waste to make a biodegradable packaging that is environmental friendly as well as cost effective. Biowaste such as rice husk and wheat straw are used with two different binders, corn starch and paraffin wax. Four different samples are prepared with different composition by mixing them and compression molding at 100° C and 4MPa pressure performed on the samples to convert it into a packaging. Different characterization techniques like SEM, XRD, FTIR, TGA and contact angle are performed to analysis characteristics of developed packaging. Mechanical, chemical, and physical tests are performed to analyze the properties and compare it with polystyrene based packaging material. Biodegradability test is performed by dumping the material in soil to check either the developed material is biodegradable or not. The characterization results shows that material developed has the same characteristics as depicted in literature. TGA indicates that developed material has more heat bearing capacity than that of petroleum-based packaging. Mechanical properties indicate that biodegradable packaging is

mechanically stronger than polystyrene based packaging. Developed material is biodegradable in nature and hydrophobic with comparable swelling properties as that of polystyrene packaging. In this study, an eco-friendly and compostable packaging material was developed using rice husk and wheat straw mixed with corn starch and wax binders. The material exhibited biodegradability, thermal stability, and superior mechanical properties compared to the petroleum-based packaging.

02002 Optimizing sustainable agriculture with enhanced nutrient efficiency through biochar-activated urea fertilizers

Mahzeb Saleem, Muhammad Bilal Khan Niazi

This research focuses on advancing sustainable agriculture practices through the synthesis and evaluation of innovative urea-adsorbed biochar fertilizers. By employing varying activation treatments, our primary objectives include enhancing nutrient retention, optimizing biochar activation methods, and assessing the agronomic performance of formulated fertilizers. This study aims to contribute to environmentally friendly fertilizers with improved efficacy, addressing key challenges in modern agriculture. Three approaches were employed for synthesizing urea-adsorbed biochar fertilizers: (1) Urea-adsorbed biochar fertilizer, (2) Urea-adsorbed H_3PO_4 activated biochar fertilizer, and (3) Urea-adsorbed KOH activated biochar fertilizer. Key steps involved Repeated Grinding, Ball Milling, Biochar Activation with H_3PO_4 and KOH, Urea Impregnation on biochar surface, and Drum Granulation. Characterization techniques included Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Fourier-Transform Infrared Spectroscopy (FTIR). Repeated grinding and ball milling ensured effective biochar particle size reduction, while activation with H_3PO_4 and KOH aimed at enhancing surface area and porosity. Urea adsorption during impregnation facilitated the synthesis of nutrient-enriched fertilizers. Drum granulation aimed at achieving uniformity for ease of application. SEM analysis showcased the unique morphology of the activated biochar and the granulated product. XRD revealed structural changes post-activation, and FTIR confirmed urea adsorption on biochar surfaces. Urea loading demonstrated superior nutrient adsorption compared to traditional fertilizers. Preliminary findings suggest improved nutrient release kinetics showcasing the potential of biochar-based urea fertilizer to mitigate nitrogen leaching, contributing to environmental sustainability. This research successfully developed biochar-based urea fertilizers, addressing inefficiencies in conventional fertilizers. SEM, XRD, and FTIR characterization techniques validated enhanced nutrient retention properties, highlighting the significance of biochar in sustainable agriculture. The study emphasizes the potential of these fertilizers in diverse agroecosystems. Further field trials will provide validation and insights for broader applications, reaffirming biochar's role in eco-friendly and efficient fertilizers for future agricultural practices.

02003 Enhancing Phosphorous fertilizer acquisition efficiency using biotechnological interventions

Zumrah Rehman, Muhammad Bilal Khan Niazi

Phosphorous (P) is major macro-nutrients for crop growth and development. A major part of applied P is not uptaken by plants as it becomes unavailable in soil. This unavailable P can be converted into available forms with different techniques, one of which is the use of Phosphate-Solubilizing Bacteria (PSB). This project aimed to coat the aqueous solution of PSB and polymer on Di-Ammonium Phosphate (DAP) granules. An aqueous solution of PSB combined with polymer was prepared and its microbial activity was evaluated. It was followed by coating of solution over DAP granules using a fluidized bed coater. The developed product was evaluated for microbial survival and tested in pot trials. SEM micrographs illustrated the compact morphology of coated DAP granules. Different surface morphology was observed with PSB and polymer coating. Fourier Transform Infrared Spectroscopy detected C–O and C–H groups confirming the presence of polymeric substances and bacteria. Sharp crystalline peaks were detected in XRD images. Plant trials are undergoing to evaluate the effect of coating over nutrient uptake. It is concluded that the application of bacteria and polymer will improve nutrient uptake in plants by increasing phosphorous availability in soil. An increase of 50-60% is expected in phosphorous availability by the application of bacteria coating.

02004 Improving mechanical properties of multilayered carbon fabric composite by nano reinforcement

Dilawar Ali, Muhammad Shahid, Sarim Ali

Carbon fibre reinforced polymer (CFRP) composites are considered as promising structural material for load bearing applications, in automotive, aerospace, sports and marine industries because of their excellent mechanical properties, high specific strength and better heat and corrosion resistance. Carbon allotropes like CNTs, GNPs and ceramic nanoparticles (NPs) can be potential reinforcements for polymer composites to enhance these properties further. This research focuses on the fabrication of multi-layered carbon/epoxy nanocomposite by using spray technique and vacuum bagging process to improve its mechanical properties. A spraying solution consisting of CNTs and SiC nanoparticles (NPs) in an ethanol solution with a little quantity of resin and hardener was prepared to modify the carbon fabrics. ZrC nanoparticles (NPs) were added to the matrix material (Epoxy) and uniformly dispersed using ultrasonic mixing and mechanical mixing. Successful fabrication of CNTs-SiC-ZrC reinforced carbon-fiber laminated composites was accomplished resulting in uniform distribution of ZrC in the binder (epoxy) matrix and CNTs and SiC NPs in the interlaminar areas. It was observed that reinforcements effectively immobilised on the surface of carbon fibres, thereby improving mechanical properties. The mechanical properties of the composite were analysed using short beam shear test to determine interlayer shear strength (ILSS) and three-point flexural test as per ASTM standards D-2344 and ASTM D790, respectively; addition of 0.25wt% CNTs and 0.25wt% SiC in coating and 0.4wt% ZrC in epoxy demonstrated relatively higher values. The ILSS, flexural strength, flexural modulus, yield strength, fracture strength and tensile strength of multi scale nanocomposite exhibited improvement by 37.4%, 16%, 11.2%, 16.1%, 13.5% and 20% respectively compared with the control sample.

02005 Laser Cladding Using Recycled Atypical Build Material

Khalid Mahmood

Metals are required to possess a combination of mechanical, physical, and thermal properties for each specific applications and it is thus difficult to find one material satisfying all properties. Laser cladding is one of the surface treatment methods in which injected metal powder is laser melted and fused to the substrate to form a thick layer. Conventionally, spherical metal powder particles produced by gas atomization are used as the clad material. However, the high cost of these powders precludes the widespread application of the process. Conversely, a large quantity of these alloys is being wasted as machining swarf in industry. This research work illustrates the use of Nickel alloy machining swarf as build material in laser cladding on mild steel substrate to establish its viability. The Response surface methodology (RSM) has been used to empirically identify the response of key coating characteristics such as clad dimensions, dilution, and hardness towards the main process parameters like laser power, scan speed and material feed rate. The microstructures and corrosion protection performance of the cladding layers have also been examined. The results indicate several significant relationships between the processing parameters and response and found comparable to those obtained with conventional spherical powder. The produced clad layers exhibited excellent corrosion resistance, confirming the viability of the atypical material form which could be used to increase efficiency of material usage, circumventing the energy intensive process of atomization. It is expected that this recycled effort could, with further development, would alleviate the cost of usual raw material and offer economical solution to the surface modifications.

02006 Beyond ordinary: Exploring the versatility of silver nanoparticles doped TiO_2 nanoparticles stabilized by short chain pyridine for textile, environmental, and biological applications

Rafia Usman Khan, Khalid Mohammed Khan, Faiza Saleem, Saman Fatima, Huzifa Ahmed, Hassan Munir

We herein report the design and synthesis of new silver nanoparticles AgNps-doped titanium dioxide nanoparticles (TiO_2Nps) stabilized by novel short-chain 5-(3-nitrophenyl)-3-(pyridin-2-yl)-4,5-dihydro-1H-pyrazole-1-carbothioamide (NPPC). The new synthetic compound (NPPC) was characterized using spectroscopic techniques such as 1H NMR, 13C NMR, and mass spectrometry. This compound is being studied for its potential biological activities, such as anticancer, antiviral,

and antibacterial properties. The short alkyl chain of NPPC effectively controlled the growth kinetics and surface morphology of AgNps-doped TiO2Nps systems. The electronic and optical characteristics of the NPPC-stabilized AgNps-doped TiO_2Nps systems were investigated using ultraviolet–visible spectroscopy (UV-Vis), atomic force microscopy (AFM), and Fourier-transform infrared spectroscopy (FTIR). UV-Vis spectroscopy of TiO_2Nps, AgNps, and AgNps-doped TiO_2Nps, all stabilized by NPCC, demonstrated signature surface plasmon resonance at 306 nm, 405 nm, and 490 nm, respectively. AFM vividly exhibited the unique size and shape of the NPPC-stabilized AgNps-doped TiO_2Nps systems with an average diameter of 3 + 1 nm. The prepared nanoparticles system exhibited phenomenal activities in biological, environmental, and textile fields. The prepared NPPC-stabilized AgNps-doped TiO_2Nps showed higher levels of antioxidant (% inhibition 82 ± 0.01%) and urease inhibition activity (% inhibition 80 ± 0.53%). Moreover, this system was successfully applied to reduce p-nitrophenol (p-Nip) and methylene blue dye. NPPC-stabilized AgNps-doped TiO_2Nps reduces the p-nitrophenol (p-Nip) and methylene blue (MB) dye to p-aminophenol (p-Amp) and leucomethylene blue (LMB) within one second in the presence of NaBH4 under ambient temperature and pressure conditions, which followed the pseudo-first-order rate kinetics. NPPC-stabilized AgNps-doped TiO_2Nps coating on cotton fabric effectively protected untreated cotton fabric from harmful UV rays demonstrated by UV-Vis spectroscopy.

02007 Hydrophobic/hydrophilic coatings in fog collectors for water harvesting applications

Danya Khan, Maria Nayyar, Rashid Ali, Muhammad Imran Khan

This research explores the hydrophobic and hydrophilic behavior of anatase titania (TiO_2) nanoparticles coating on polypropylene (PP) and viscose yarn for water harvesting applications. These coatings will enhance the fog-collection efficiency and water condensation properties of the fog collector. The main idea came from nature. Spider web acts as hydrophilic threads that collect water from the environment. Grass shows hydrophilic and hydrophobic behaviour and, through condensation, collects water from the environment and sends it to the roots of the plants to grow. Titania nanoparticles are the primary material because of their hydrophobic and hydrophilic nature. The titania nanoparticles show hydrophilic properties below pH of 6.2 and hydrophobic properties above pH of 7. The electrostatic state of the TiO_2 solution is from the pH of 6.3 to 7.0. When pH is below 6.3, the titania is protonated forming a Ti-OH bond, and positive charges are formed on the surface of the TiO_2 due to which attraction of water occurs. When TiO_2 has pH > 7.0, it shows hydrophobic behaviour because the OH- ions are formed, and the surface becomes negatively charged due to which repulsion of water occurs. The purpose is to enhance the hydrophobic and hydrophilic properties of the mesh material, in such a way that hydrophobic, PP yarn, and hydrophilic, viscose yarn, are woven together after coating in the basic and acidic solutions of TiO_2, respectively. Before dip-coating of yarns in TiO_2 solutions, the yarns were cleaned in the distilled water and ethanol solution and then dried in oven at 120 °C. After applying the TiO_2 coatings, yarns were again fully dried in the oven at 130°C. Polypropylene (pp) yarn is treated with a hydrophobic solution, basic solution of TiO_2, while viscose yarn is treated with a hydrophilic solution. FTIR results confirm the presence of functional groups of hydrophilic, Ti-OH, and hydrophobic, -OH group, in the produced coatings. X-ray diffraction (XRD) confirms the TiO_2 as anatase phase. The contact angle of ± 35°, ± 100° of TiO_2 produced hydrophilic and hydrophobic coatings was measured using a water drop test. Scanning electron microscope (SEM) and EDX confirm the TiO_2 on yearns. The study contributes insights into developing advanced materials for sustainable water sources.

02008 The role of grain boundary texture during grain boundary migration

Waseem Amin, Abhishek Biswas, Napat Vajragupta, Alexander Hartmaier

This work focuses on the evaluation of role of grain boundary (GB) texture on dynamic grain boundary migration in multi-crystalline Aluminum specimen. The analysis is done with the help of MultiPhase Field-Strain Gradient Crystal Plasticity modeling and simulation using OpenPhase software. This approach is well-known to capture the multiphysics nature of such grain boundary related processes where deformation takes place simultaneously with the evolution of microstructural. The simulations of one dimensional tensile tests are performed with various values of brain boundary mobility which correspond to different material processing temperatures. The results highlight the relationship between grain boundary texture and the rate of grain boundary migration, and it also relates with grain boundary mobility under the application of thermal and thermo-mechanical loads. It is observed that grain boundary migration is accelerated if the

microstructure is very fine. Moreover it is also influenced by average angle of grain boundary disorientation, the application of thermo-mechanical load, and direction of loading axis which exists due to grain boundary disorientation anisotropy.

02009 Understanding the electrochemical behaviour of MnO_2 based cathodes for Zn-Ion Batteries

Kabeer Raza, Zaeem-ur-Rahman, Muhammad Umair, Moaqir Sultan, Syed Adnan Kazmi, Eisha Maham, Muhammad Asif Hussain, Waseem Amin

Zn Ion Batteries (ZIBs) are the ultimate solution to fulfil the energy storage demands for the local industry of Pakistan. The materials used in the development of ZIBs are non-hazardous, non-explosive, abundant in Pakistan and easily available at low cost. Also, the electrolytes for ZIBs are flexible and can be liquid, semisolid or solid. Unlike Li or Na –Ion batteries, the development of ZIBs does not require costly equipment. Therefore, development of ZIBs is vital for the local industry of Pakistan. In this work, the electrochemical behaviour of various variants of α-MnO2 synthesized by hydrothermal route is studied. The variants of α-MnO2 include those synthesized at variable processing temperature, with and without calcination, and electrodes with carbon black and expanded graphite. α-MnO2 synthesized at 160 °C, and used as cathode material without calcination has shown higher power density when compared with those synthesized at 140 °C or 180 °C or used as cathode with calcination. The addition of carbon black or expanded graphite is meant to accelerate electron conduction, however, the former has shown a higher power density (a super capacitor like behaviour) and the later has shown a higher energy density (a battery like behaviour) when compared with each other.

02010 Conductive polymeric coated textile fabric-based supercapacitor electrode for wearable applications

Awais Sattar Ghouri, Rabya Aslam, Syed Nadir Hussain, Muhammad Saqib Siddiqui

In the past few years, perpetual and significant progress has been made in developing and innovating flexible, bendable and stretchable supercapacitors ascribed to their outstanding application in the realm of wearable technology, such as e-textile, smart and intelligent apparel, and body-worn interactive clothing. One of the numerous flexible supercapacitors, accordant well-functioning textile-based supercapacitors have emerged as compatible and viable contender for portable and wearable devices because of their good flexibility, excellent charging-discharging rates, high power densities, long shelf life, safe usage, and conformable to the human body. Textile-based supercapacitors having both synergetic effects of non-Faradaic double layer charge mechanism combined with Faradaic redox reactions of conducting polymer to achieve high effective capacitance and high energy storage densities have not been reported yet. In the present work, various commonly used textile-based fabrics such as cotton, polyester-cotton (PC 65:35), and polyester fabric are used to develop electrodes using a range of conductive polymeric coatings using dip coating methodology, knife coating, dip coating followed by knife coating, and padding method. The developed electrodes are thoroughly examined for electrochemical analysis including Cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), electrochemical impedance spectroscopy (EIS), and Current-voltage (I-V) measurement. With enhanced power density, electrical conductivity, and stability, the developed supercapacitor electrode produced capacitance values over cotton fabric that were comparable to those described in the literature. Cotton fabric, among other textile materials, is regarded to be our main emphasis because it is a cellulose-based material having key features of softness, biodegradability, sustainability, breathable, non-toxic, less dense, renewable, cheap, readily and abundantly available, conformable and compatible with human skin, comfortable to wear, and is not harmful to human health, which will make this electrode more environmentally friendly.

02011 Synthesis and electrochemical evaluations of PANI, PANI/CNTs, CoP-PANI/CNTs composites as potential cathode electrodes for supercapacitor applications

Waseem Shehzad, Muhammad Ramzan Abdul Karim, Muhammad Hamza, Mahad Siddiqui, Muzammil Mughees

PANI and PANI/CNTs are highly conductive and more susceptible to accommodating metal phosphate through chemical linking. They are the best active materials for supercapacitors due to their ideal hierarchical structure, strong chemical coupling. In the present study, PANI, PANI/CNTs

were prepared by in-situ polymerization method followed by synthesis of $Co_3 (PO_4)_2$ – PANI/CNTs through sonochemical assisted approach. All the hierarchical structures of prepared compositions were studied with scanning electron microscopy (SEM) and compositional analysis were done through X-ray diffraction which presented different graphitic plains (CNTs), PANI, and different peaks of $Co_3 (PO_4)_2$ (CoP) in the relevant samples. Among all compositions, CoP-PANI/CNTs presented best specific capacity (419 Fg^{-1}) at 0.4 Ag^{-1} current density, low solution resistance (Rs), and low charge transfer resistance (Rct). The best performance was attributed to stable chemical grafting of PANI functionalized CNTs and CoP which have conductive pathways, high surface area, porosity. These all things make CoP-PANI/CNTs a potential electrode material for supercapacitors applications.

Abstracts for Poster Presentations

03001 Prediction of elective patients and their duration of stay in hospital by using ai techniques

Muhammad Shahzad Saleem, Saif Ullah

In the realm of healthcare management, efficiently predicting the admission and length of stay (LOS) for elective patients is pivotal for optimizing hospital resource allocation and enhancing patient care. In order to make sure that patients receive the best care, hospitals are paying more attention to how they manage their resources. They want to spend less money while still giving good care to patients. Hospital managers focus on planning by deciding what facilities and staff are needed to run the hospital well and meet patients' needs. There are different methods to predict how many patients will come to the hospital, how many beds will be needed, and how those beds will be used. The most important part of these methods is accurately guessing how long patients will stay in the hospital and understanding what things affect how long they stay. The stay in hospital (StayinHos) for a patient in a hospital refers to the number of days they spend in the hospital during one admission. It's a key factor in understanding how much of the hospital's resources a patient consumes. StayinHos also helps us understand how patients move through different parts of the hospital, which is important for evaluating how well the hospital is running. StayinHos is often used to measure how much resources are being used, the cost of treatment, and how severe a patient's illness is. Some studies have tried to group patients based on their medical conditions, assuming that each condition has a recommended stay in hospital. However, the stay in hospital (StayinHos) is a complicated concept influenced by many different factors, some of which may even compete with each other. These factors include a patient's personal characteristics, reason for admission, any complications that arise during their stay, and plans for discharge. Moreover, there are potential risks for patients who stay in the hospital longer than necessary for active treatment. Remaining in the hospital when they could be discharged increases the chances of experiencing falls, acquiring infections specific to hospitals, and encountering medication errors. These risks are particularly concerning for patients who are fit to leave the hospital. Proactively managing discharge procedures starting early in the admission process and minimizing stay in hospital can help prevent such complications.

03002 Development of Ag_2S-based nano-fertilizer in agricultural applications

Aiman Tanveer, Muhammad Umer, Saqlain Abbas, Muhammad Abdul Basit

The increasing demand for sustainable agriculture calls for the development of innovative and eco-friendly approaches to improve crop yield and nutrient utilization. This study is focused on the creation and use of silver sulfide (Ag_2S) and Ag_2S/ZnO nanoparticles as revolutionary nano-fertilizers for agricultural practices. The main objective is to enhance nutrient delivery efficiency, stimulate plant growth, and reduce the environmental impact caused by traditional fertilization methods. In the first phase, Ag_2S nanoparticles were synthesized using a simple and cost-effective chemical method. Characterization techniques such as Particle Size Analysis (PSA), Scanning Electron Microscopy (SEM), Energy-Dispersive X-Ray Spectroscopy (EDS), and Fourier Transform Infra-Red Spectroscopy (FTIR) were employed to analyze the size, morphology, and crystalline structure of the synthesized Ag_2S nanoparticles. The obtained results confirm the successful fabrication of uniform and well-defined nanoparticles. Following the successful synthesis and characterization of Ag_2S nanoparticles, a new type of fertilizer has been created that combines Ag_2S nanoparticles with zinc oxide (ZnO). The structural and morphological properties of the Ag_2S/ZnO nano-fertilizer were thoroughly investigated using various spectroscopic and microscopic techniques. The results indicated a well-defined and stable structure, paving the way for further agricultural applications. The utilization of Ag_2S and Ag_2S/ZnO nano-fertilizers shows great promise in mitigating the negative environmental effects of conventional fertilization in agriculture. Recent

research provides a foundation for further investigation into their agricultural implications, contributing to sustainable practices to meet the demand the growing demand for food production while minimizing environmental impact.

03003 Fabrication of iron oxide coated silica submicron composites for biomedical applications

Muhammad Umar Shafique, Fatima Zaidi, Zoha Zulfiqar, Syed Mujtaba ul Hassan, Jamil Ahmad

Nanoparticles (NP's) are becoming very promising in the area of targeted drug delivery system. The arrival of nanotechnology has provided an advantage to drive diagnosis and therapy close to each other.this research work mainly focus on the theranostic applications of nanoparticles by using the composite of silica and iron oxide particles. First the iron oxide nanoparticles (magnetite Fe_3O_4) of size approximately 10 to 30 nm were prepared by using coprecipitation method and modified co-precipitation method. Then these nanoparticles were coated with the different polymers like PEG and DMSA to make them stable and biocompatible, control their size and to prevent the agglomeration of particles. Then the silica (SiO_2) submicron spheres were prepared by using sol-gel method and stobber's method of the particle size 400 nm to 600 nm. These silica nanoparticles were coated with polymers like PVP, CTAB and Chitosan. The mesoporous silica will be obtained by using calcination at 600ºC for 12 hours in the sol-gel method and also by using surface protected etching phenomena by using NaOH in the stobber's method. For size, crystallinity, morphology and purity determination these nanoparticles were characterized by using following techniques: For size determination scanning electron microscopy (SEM) and X-ray diffraction (XRD) will be used. The crystallinity will be checked through XRD and morphology will be confirmed by (SEM).Purity of particles will be checked by using energy dispersive spectroscopy (EDS). Coating of the nanoparticles will be confirmed by using Fourier transform infrared spectroscopy (FTIR). Silica spheres will be coated with iron oxide via 24-hour physical mixing in acidic media. The resulting composite submicron spheres will undergo labeling with the radioisotope 99mTc, and labeling efficiency will be assessed through paper chromatography. The biodistribution of these labeled spheres will be studied by injecting them into rats and subsequently comparing the results. The MTT assay was also carried out to check the cytotoxicity and biocompatibility of these nanoparticles. Their results showed less cytotoxic system with cell viability greater than 90% in all cases. This research focused on making special particles called iron oxide coated silica nanocomposites (IONPs). We used two methods to make the iron oxide part and two methods for the silica part. By mixing them in acidic conditions, we created these nanocomposites. Different tests like FTIR, SEM, and XRD helped us understand their features. The iron oxide particles were around 10-20 nanometers, and silica particles were 400-600 nanometers. We checked their purity using EDS, and FTIR confirmed the coating with different materials. We also tested if they are safe for cells using MTT assays, and the results showed they are not harmful. In another part, we labeled these particles with a special material (99mTc) and found they were highly efficient. Finally, in mice, we studied where these particles go in the body, and we discovered they mostly end up in important organs like the liver, lungs, spleen, and kidneys.

03004 Improving thermal stability and electrical properties of PVDF – HFP/PVDF blend by incorporating novel surface-decorated BaTiO3@GNPs nanoparticles for dielectric applications

Muhamamd Farhan, Zia Ud Din, Mubashra Khan, Huma Ramzan

The importance of transitioning to renewable energy is important due to the depletion of finite fossil fuel supplies becomes a major cause of climate change, as well as the rising demand for energy worldwide. However, efficient harvesting of renewable energy remains a challenge. Compared to other storage technologies, dielectrics hold significant properties like increased power density and cycle stability, however, low energy density. This study explored the development of novel polymer nanocomposites with improved properties for potential use in dielectric applications. We synthesized surface-decorated $BaTiO_3$@GNPs nanoparticles using a wet chemical method and incorporated them into a PVDF-HFP/PVDF blend at varying weight percentages of 0, 5, and 10 labelled as A, A-5, and A-10. Our aim was to enhance the thermal stability and improve electrical properties of PVDF- HFP, PVDF polymer blend by incorporating novel surface-decorated $BaTiO_3$@GNPs nanoparticles for dielectric applications. Verification of successful fabrication of surface-decorated

nanoparticles was done through XRD analysis. Uniform nanoparticle dispersion was proved by SEM and presence of constituent elements in the nanoparticles was evident from EDS. Enhanced thermal stability of $BaTiO_3$@GNPs/PVDF-HFP, PVDF nanocomposite, as evidenced by thermogravimetric analysis. Improved dielectric properties. The 10 wt.% $BaTiO_3$@GNPs nanocomposite exhibited the highest relative permittivity (36.88) and AC conductance (26.00 x 10-6 S/m) at 0.5 MHz.

03005 Design and development of a 2-DoF bionic ankle-foot prosthesis for agile walking on uneven terrains

Moiz Taha, Muhammad Ahmad Adil Khan, Muhammad Asad Mazhar

Through this project, we aim to develop a 2DoF ankle-foot prosthetic and tackle the pressing need of ankle-foot prosthetics in Pakistan. The project thoroughly explores biomechanical principles, incorporating environmentally friendly approaches and focusing on affordability, incorporating technologies to mimic natural ankle movement. Our goal is to create an affordable, sustainable, and adaptable prosthetic that can significantly improve the lives of amputees, providing them with a more affordable and natural walking experience.

03006 A facile synthesis of nickel oxide and tin oxide composites via co-precipitation method for supercapacitors

Aqsa Amir, Muhammad Asif Hussain, Muhammad Faisal, Sajid Ali1, Moazzam Ali, Mohammad Sami

Nickel oxide (NiO) and tin oxide (SnO_2) nanoparticles have gained considerable interest from researchers owing to their outstanding performance in capacitor applications. However, simple, and inexpensive synthesis routes need to be developed to produce them in bulk quantity. Therefore, a simple co-precipitation method has been developed to synthesize them. In addition to that composite materials of both oxides have been suggested for supercapacitor applications. In the present investigation, a modified co-precipitation method has been applied to synthesize the nanoparticles of NiO and SnO_2 from $NiCl.6H_2O$ and $SnCl_4$ solutions respectively. The obtained powders were calcined at 500 ℃ to achieve the crystallinity of the powders. The nanocomposites of three different ratios of NiO:SnO_2 (i.e., 1:1, 1:1.5, 1:2) by coprecipitation method, and then a thin coating of the composites slurry made with ethanol and Nafion binder was developed on the nickel foam to develop the anode electrode for supercapacitor. Scanning electron microscopy (SEM) coupled with energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), and Fourier Transform Infrared Spectroscopy were utilized to characterize the nanoparticles as well as nanocomposites. The electrochemical study of NiO and SnO_2 composites was carried out by cyclic voltammetry technique. XRD analysis revealed the crystalline nature of the nanoparticles and nanocomposites. The purity of the phases was also confirmed by the XRD analysis because no other phase was detected in the XRD results of the composites. The crystallite sizes of NiO:SnO_2 (i.e., 1:1, 1:1.5, 1:2) measured by Debye Scherre's method were in the range of ~12–17 nm. Morphological analysis revealed the formation of homogeneous nanocomposites. The particles are well distributed in all compositions. The electrochemical analysis results showed that the NiO/SnO_2 composite electrode with 1:1 showed the highest specific capacitance of 1361.28 F/g than NiO/SnO_2 (1:1.5 and 1:2) composite electrodes i.e., 1021.20 F/g and 938.25 F/g, respectively. NiO/SnO_2 (1:1, 1:1.5,1:2) nanocomposites were successfully synthesized by a simple co-precipitation technique using inexpensive raw materials. The crystallite size as determined through XRD and particle size as measured through SEM analysis confirmed that synthesized particles are in the nanometer range. Highly pure composites were synthesized as confirmed by the FTIR and XRD analysis. The specific capacitance of NiO/SnO_2 (1:1) nanocomposite was the highest of all and it can be used for energy storage devices and can be commercialized due to inexpensive raw materials and simple synthesis method.

03007 Polyvinyl alcohol and calcium silicate hydrate nanoparticles along with oleifera moringa deposition on stainless steel using electrophoretic deposition for orthopedic implants

Esha Ghazanfar, Mohsin Ali Marwat

Metals are commonly used in bone implants due to their high strength and load-bearing properties. However, they are susceptible to local corrosion and biofilm formation. These issues require an implant with enhanced biocompatibility, bioactivity, and antibacterial effects. The orthopedic

industry generally utilizes stainless steel-based implants because of their good mechanical properties and cost-effectiveness. To address the above-mentioned challenges, we designed composite coatings containing synthetic biopolymer polyvinyl alcohol (PVA), calcium silicate hydrate (C-S-H) nanoparticles for augmented bioactivity and antibacterial effect, and oleifera moringa to enhance the osteogenic induction and deposited it on the 316L stainless steel via electrophoretic deposition (EPD). The outcomes validated that the composite film provides biocompatibility, bioactivity, and antibacterial characteristics to the stainless-steel orthopedic implants with an economical approach to accomplish these requirements.

03008 Simulation of lead-free perovskite solar cell using SCAPS 1D

Haleema Sadia, Azkar Ul Hasan, Shanza Rehan

The first perovskite solar cell (PSC) was reported just a decade ago and has gain significant attention due to its cost effectiveness, tunable band gap, high absorption coefficient, ease of fabrication, high efficiency and many more. In spite of the fact that lead based perovskite solar cell (PSC) has the supreme power conversion efficiency (25.73%) and minimal stability issues, researcher communities are progressively switching towards lead free PSC due to its uttermost toxic nature. Tin being above lead in periodic table has almost similar optoelectronic properties and less toxicity issues. Theoretically, tin based PSC having power conversion efficiency of 33.4% is overhead lead based PSC that has 32.1% power conversion efficiency. However, the presence of dangling bonds (unpaired electrons) at the surface of tin based perovskite is the main reason behind oxidation. Additive and interface engineering are the well-known passivation techniques used to overcome the degradation issue. In order to improve the efficiency and stability we simulate hetero-junction inverted perovskite solar cell structures using Solar Cell Capacitance Simulator SCAPS-1D. Herein, we study the effects of varying additives, active layer's (perovskite) composition and also study the effects of parameters like layer thickness, band-gap, temperature, defect density, work-function, electron affinity, Hole transport layer/perovskite interface and perovskite/electron transport layer interface. Under real life conditions we produce current density–voltage and external quantum efficiency curves of our device and compare it with the reference device. Our reference single junction device FTO/PEDOT:PSS/Al_2O_3/FA0.8MA0.2SnI3/PCBM/BCP/Ag has open circuit voltage, short circuit current density, fill factor and power conversion efficiency of 0.807 V, 20.32 mA/cm2, 57.54 and 10.49 respectively. Herein we give perception about how varying external factors, composition and interface of perovskite layer can improve the device performance and stability.

03009 SCAPS-1D Simulation of Stable and Efficient Air-Processed Lead Based Perovskite Solar Cells

Irshad Ali, Shanza Rehan

Skyrocketed increase in the efficiency of organic-inorganic hybrid lead based perovskite solar cells (PSCs) caught the attention in the field of energy harvesting technology. But one major problem of this technology, which hinder its commercialization, is its fabrication in industry environment or may called as air processed. Many efforts have been made to fabricate these solar cells (SCs) in normal lab environments. Different combinations of the active layer are fabricated and tested in ambient environment and environmental humidity and temperature. Among these, air processed mixed A site cation and mixed X site cation lead based PSCs showed excellent stability against heat and humidity. Here we simulated lead based hybrid PSC, having mixed A cation (organic-inorganic combination) and mixed X anion (two halides) with novel combination of the hole transport layer (HTL) and electron transport layer (ETL), using SCAPS-1D interface. We used ⟦FA⟧_0.85 ⟦Cs⟧ _0.15 Pb(I_0.85 ⟦Br⟧_0.15)_3 as absorber layer. Since FA is sensitive to temperature and humidity but is more efficient than MA based PSCs. Addition a small proportion of Cs at A site to FA significantly improve its temperature and humidity resistance. n-FASnI_3 is used as ETL along with FTO glass substrate. p-FAGe⟦Cl⟧_3 is used as HTL with Au as back electrode. The overall structure of the simulated device is FTO Glass/n-FASnI_3/⟦FA⟧_0.85 ⟦Cs⟧_0.15 Pb(I_0.85 ⟦Br⟧_0.15)_3/ p-FAGe⟦Cl⟧_3/Au.

03010 Battery-grade silver citrate-nickel hydroxide-multiwalled carbon nanotubes nanocomposites for high-performance supercapattery applications

Kanwar Muhammad Adam, Syed Muhammad Abdullah, Mohsin Ali Marwat

Supercapacitors and battery-grade materials merge to form a supercapattery system, addressing energy storage disparities. Five distinct battery-grade Ag-citrate-$Ni(OH)_2$-MWCNTs nanocomposite electrodes were synthesized, which exhibited exceptional electrochemical properties. Advanced characterization techniques confirmed successful synthesis. The supercapattery device achieved high energy and power densities, with significant capacity retention and Coulombic efficiency over 3000 cycles. Power law analysis supports the concept of a battery-grade supercapacitor. The study underscores the potential of these nanocomposites for superior energy storage and cycling stability in supercapattery applications.

03011 Porous Ti-3Cu scaffold designing using Mg as a space holder for orthopaedic implants

Kashif Iqbal, Shamal Khan, Zulqurnain, Esha Ghazanfar, Mohsin Ali Marwat

Microwave sintering with Ti-3Cu for orthopedic implants, utilizing Cu's antibacterial properties and Mg as a space holder, enhances biocompatibility. Varying pressures adjust porosity and elastic modulus. Higher sintering temperatures and pressure intensify Ti-Cu diffraction peaks, impacting pore structure and reducing porosity. Elevated temperatures boost compressive strength and elastic modulus, mimicking human cortical bone. Enhanced corrosion resistance is observed at higher temperatures in simulated body fluid.

03012 Fabrication of flexible RFID for enhanced security authentication system

Lyba Siddiqui

Radiofrequency Identification is a wireless automatic identification system that uses electromagnetic waves to capture and retrieve data. It consists of three main components: tags, readers, and a software system for processing data storage. By using the Radiofrequency Identification principle, this project aims to enhance the manual verification or attendance system of students with easy implementation at any institute or campus. A basic mode of RFID is developed, which holds the microcontroller ATMEGA328, offering Dual In-Line Package (DIP) easy removal of the chip to process various components. A Type A tag compliant with ISO144434 is embedded on the student's ID card for verification. The transfer data rate of the Type A tag is 25 Kbits/s. An RC522 with an MFRC522 chip reader module is deployed to detect the signal of frequency 13.56 MHz with a range of 50 millimeters. A PCF874T I2C LCD Driver is connected to a 1602LCD display to translate signals and display messages on the screen. Besides the display message, two LEDs of white and green lights are also used to distinguish authorization and denial, respectively. Additionally, the feature of card revocation and registration process by buttons in the system offers feasibility. Ten cards can be registered onto the device. The device uses a 2-second interval between message displays during activation and 1 second during denial. The system provides a promising solution to optimize the accuracy and efficiency of the student's verification or attendance system by implementing RFID technology.

03013 Ultrahigh energy density and high thermal stability in novel bilayer-structured nanocomposites with surface-decorated TiO2@BaTiO3 nanoparticles

Zia Ud Din, Esha Ghazanfar, Mohsin Ali Marwat

Renewable energy storage demands high-performance dielectric capacitors. Bilayer nanocomposites, integrating TiO2@BaTiO3 nanoparticles, offer promise for improved energy storage. In a bi-layered nanocomposite film, different weight percent of TiO_2@$BaTiO_3$ nanoparticles were introduced in a blend of PVDF and PVDF-HFP while the Bottom layer is made of Linear polymer PEI. The resulting bilayer nanocomposite film demonstrates superior characteristics, including high permittivity, Eb, discharge energy density, and charge-discharge efficiency. Finite Element Analysis (FEA) validates electric field redistribution, crucial for enhanced energy storage properties.

03014 Synthesis and characterization of carbon quantum dots coated graphitic carbon nitride as a nano carrier for targeted drug delivery in cancer treatment

Laiba Noor, Dr. Muhammad Abdul Basit

Cancer has been the second leading cause of death globally after cardiovascular diseases. The research emphasizes in the advancement of treatment technique by synthesizing a new synergistic Nano Material in the field of Nano Technology by coating Carbon Quantum Dots on Graphitic Carbon Nitrides due to their excellent properties especially Bio Imaging and Metal Free respectively for biomedical Applications. The material is being further Characterized by Material Based Characterizations using various direct and indirect Techniques like X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), UV –Visible Spectroscopy, Particle Size Analysis, Energy Dispersion Spectroscopy (EDS). Moreover, Application Based Characterization like Anti-Bacterial Testing, Cell-Culture, Anti-Cancer cell Testing, Zeta Potential for the analysis of Application. The research will help in the advancement of Cancer Treatment by acting as a Nano carrier for targeted drug delivery and will be an advance material in future by further research and testing on advanced level. The results suggest promising prospects for targeted cancer therapy, indicating the Nano carrier potential as a flexible platform for advanced drug delivery techniques. This study represents a significant advancement in the field of cancer treatment, offering a promising avenue for the development of improved drug delivery systems with enhanced efficacy and specificity.

03015 Ammonium fluoride treatment of silica nanoparticles for solar collector

Zara Fatima, Hafsa Farooq, Arooj Javaid, Waleed Aslam, Dr. Abdul Faheem

Silica nanoparticles (NPs) have gained significant importance and find a wide range of applications due to their unique optical and electronic properties. Using simple wet-chemical approach, we can have precise control over size and distribution of SiO_2 NPs. SiO_2 NPs can also be functionalized to enhance hydrophobicity, exhibit favorable solubility characteristics in polar solvents like water, and have a refractive index of 1.43 which enables light transmission, making them valuable for a variety of optical applications. In this perspective, we have prepared silica nanoparticles (SNPs) through modern Stöber process for the photovoltaic applications. We used tetraethyl orthosilicate (TEOS) as precursor, TEOS allows for precise control over the size of silica nanoparticles and readily dissolves in organic solvents like ethanol and water making synthesis easy. After the completion of process, the morphological and structural properties were characterized using various techniques including scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR). The average ~300-350 nm size particles were obtained. We then treated SNPs by making a 0.01M solution of NH_4F. as a result new bonds emerged. SNPs were coated on the ITO glass substrate using spin coating method. We are yet to analyze the effect on the newly emerged bonds on SiO_2 behavior.