

## Proceedings of 2<sup>nd</sup> IGCSEPS -2024

### 2<sup>nd</sup> International Graduate Conference on Software Engineering and Physical Sciences



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Govt. Islamia Graduate College Civil Lines Lahore

**2<sup>nd</sup> International Graduate Conference on Software Engineering and Physical Sciences**

**Departments of Physics & Software Engineering**

**Lahore College for Women University.**

**Govt. Islamia Graduate College Civil Lines, Lahore.**

# **2<sup>nd</sup> IGCSEPS -2024**

Proceedings of papers

Organized by: Departments of Physics & Software Engineering, LCWU and GIGCCL Lahore, Pakistan

**September 04 and 05, 2024**

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## About 2<sup>nd</sup> IGCSEPS -2024

**2<sup>nd</sup> IGCSEPS** is a 2nd International Graduate Conference on Software Engineering and Physical Sciences September 04 and 05, 2024 at Lahore College for Women University Lahore and Govt. Islamia Graduate College Civil Lines Lahore Pakistan. The ultimate ambition of this conference is to bridge the gap between Physics and Emerging Science aiming at technological opportunities for college students and researchers. Advanced technologies promise novel revolutionary products and methods in numerous areas of application. Renowned National and International researchers have been invited as keynote talks at this prestigious conference. Scientists working in research fields related to IGCSEPS -2024 topics are to submit papers. All accepted papers (presented at the conference and following IEEE format) will be submitted and published in the Pakistan Journal of Emerging Science and Technologies (PJEST), Department of Physics, Govt. Islamia Graduate College Civil Lines Lahore, Pakistan.

**Venue:** Lahore, the eternal city, is one of the oldest cities in the world with a vivid and rich history and culture, records the great changes of the Pakistani nation just like a living history book. Lahore is the capital of the Pakistani province of Punjab and is the country's 2nd largest city after Karachi, as well as the 18th largest city proper in the world. Lahore is one of Pakistan's wealthiest cities with an estimated GDP of \$65.14 billion (PPP) as of 2017. Lahore is the largest city and historic cultural centre of the wider Punjab region and is one of Pakistan's most socially liberal, progressive, and cosmopolitan cities.

## Message from Organizing Committee

It is our pleasure to have all of you engaged in the 2nd International Graduate Conference on Software Engineering and Physical Sciences (IGCSEPS). This International Conference is held in Lahore College for Women University Lahore and Govt. Islamia Graduate College Civil Lines Lahore on September 04 and 05, 2024. This one-day conference focuses on the current research in Emerging Science and related technology. The conference aims to be a key international forum for the exchange and dissemination of technical information in every field of science.

The conference features technical presentations that cover topics of current interest in the area of Plasma Physics, Quantum Entanglement, Organic Framework Nanoparticles: Synthesis and Applications as Cancer biomarkers, trace determination of inorganic/organic analytes, Photocatalysis for Environmental application, simulation, modelling and energy saving. Renowned researchers will give keynote speeches at this prestigious conference.

Therefore, this conference can be considered as an ice breaker for the local and international logistics industry to understand Sri Lanka, South Asia and the Indian Ocean opportunities for more efficient technology-based skilled solutions to be discussed to re-position and invest pragmatically in an emerging region of the world. The world is moving into an emerging science revolution transforming with fifth-generation technologies. We believe staff and students of Govt. Islamia College Civil Lines Lahore will have a great opportunity to learn from the network of renowned researchers and scientists and discuss, and understand how the emerging Science will transform over the next few decades through the discussions and ideas presented at the IGCSEPS -2024. Therefore, it is very necessary that such conference must be carried on annually.

We are pleased to announce that we are launching the Pakistan Journal of Emerging Science and Technologies (PJEST) and selected papers will be published in the Journal. We wish you all enjoy the conference and the wonderful city of Lahore. Please do not hesitate to ask our staff for any queries and assistance.

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## **Keynote Conference Talks**

**T**itle of the talk: **Quantum Tunneling in Semiconductor Nanostructures by Matrix Method**

**Dr. Afaq Ahmad**

CSSP, University of Punjab, Lahore

**T**itle of the talk: **Optimized Electrochemical Properties of Magnesium-Doped Tungsten Sulfide Supercapacitors via Green Synthesis with Camellia Sinensis**

**Dr Muhammad Iftikhar**

HOD Physics, University of Lahore

# Abstract of Accepted Papers

## QUANTUM TUNNELING IN SEMICONDUCTOR NANOSTRUCTURES BY MATRIX METHOD

Afaq Ahmad  
University of the Punjab

**A**bstract: Quantum tunneling in semiconductor nanostructures is a crucial phenomenon in modern electronics. In this article, single and double barriers heterostructures of semiconductor materials *InN* and *GaN* are used to find the quantum tunneling transmission probability using the matrix method. This powerful technique analyzes and solves the Schrödinger equation in these heterostructures. A double-barrier structure displays resonant tunneling depending on the distance between the barriers and the energy of the quantum particle relative to the potential height. On the other hand, a single-barrier structure does not display resonant tunneling but its transmission probability depends on the width of the barrier. Since the transfer rate of electrons in the devices through resonant tunneling is much faster than the drift and diffusion processes. So, resonant tunneling is usually employed to enhance the high-speed responses. This study is important in devices like tunnel diodes, quantum dots, and transistors at the nanoscale.

**Keywords:** *Heterostructures, Matrix method, Quantum Tunneling, Transmission Probability*

## OPTIMIZED ELECTROCHEMICAL PROPERTIES OF MAGNESIUM-DOPED TUNGSTEN SULFIDE SUPERCAPACITORS VIA GREEN SYNTHESIS WITH CAMELLIA SINENSIS

Muhammad Iftikhar  
University of Lahore

**A**bstract: This study aimed to synthesize and evaluate magnesium-doped tungsten disulfide (Mg-WS<sub>2</sub>) prepared by green synthesis technique through camellia sinensis extract. The X-ray diffraction (XRD) study verified alterations in the structure, specifically the creation of a hexagonal structure. The d-spacing exhibited a marginal increase from 5.967 Å in the pure WS<sub>2</sub> to 6.027 Å in the doped sample. Key vibrational modes, such as W-S, and S-S bond vibrations, crucial for preserving material integrity, were found using Fourier-transform infrared (FTIR) spectroscopy. UV-Vis spectroscopy showed a blue shift, indicating an increase in the energy difference between the valence and conduction bands, which suggests enhanced optical characteristics. The decrease in absorption by UV-Vis spectroscopy in methylene blue (MB) dye demonstrated that Mg-WS<sub>2</sub> is porous, facilitating that more electrolytes within the electrode be adsorbed. The electrochemical tests, such as cyclic voltammetry (CV) and galvanostatic charge-discharge (GCD), showed an improvement in specific capacitance and energy density. In addition, electrochemical impedance spectroscopy (EIS) showed a notable decrease in charge transfer resistance and a considerable rise in the ion diffusion coefficient. The results highlight the capacity of Mg-WS<sub>2</sub> as an exceptional material for supercapacitors.

## STUDY THE ANSYS THERMAL ELECTRIC SIMULATION TO ANALYSE THERMOELECTRIC GENERATOR OPERATIONS GENERATING CURRENT THROUGH HEAT ABSORPTION

Muhammad Sufian, M. Javaid Afzal  
Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: Thermoelectric generators (TEGs) transform heat directly into electricity, providing sustainable energy solutions for many industries. TEGs can recover energy from industrial and automobile exhaust gasses. TEGs use waste heat to generate sustainable energy and reduce greenhouse gas emissions and climate change. TEGs save energy and reduce fossil fuel use by turning waste heat into power. TEGs can also be used in industrial and off-grid sites to generate power and improve energy availability. This study utilizes ANSYS software to simulate thermoelectric generators (TEGs) and their complex operation. A powerful simulation tool, ANSYS, helps analyze TEG structure factors including temperature distribution and total current density. This study employs copper material to provide better results than previous tests that used aluminum material. Due to its superior thermal conductivity, copper is a better heat conductor than aluminum. It is therefore a good selection in situations where efficient and quick heat transfer is required. Because copper resists corrosion better than aluminum, it is a better material for applications that will be subjected to severe environments. The work accurately models TEG heat transport and electrical generating processes using ANSYS simulation, revealing their performance. Optimizing TEG designs for efficiency and reliability requires advanced simulation tools like ANSYS. The study emphasizes TEGs' role in sustainable energy and resource conservation. This study improves our understanding of thermoelectric generator technology and its energy harvesting and waste heat recovery applications. Researchers can improve TEG designs and performance using ANSYS simulation, enabling a more sustainable energy future.

## HEAT TRANSFER ANALYSIS OF Al<sub>2</sub>O<sub>3</sub> NANOPARTICLES

Nazim Ali, M. Javaid Afzal  
Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: The capability of temperature variation is essential for cooling industrial operations like transportation such as car and heavy vehicle radiators, electronics devices, petroleum industrial systems, etc. Different methods and fluids are used in the cooling process in industrial systems. The basic fluids are based on temperature, thermal stability, and the effectiveness of heat transmission. Thermal characteristics improve when nanoparticles are added to the basic fluid. Using Al<sub>2</sub>O<sub>3</sub> nanofluid the heat transfer and variation in the temperature at the entrance side and outlet side of the micro-channel pipe were studied. Through ANSYS Fluent, a well-defined method for utilizing Al<sub>2</sub>O<sub>3</sub> nanofluids to investigate the impact of various performance optimization factors of nanofluids was performed. The temperature of the nanofluids at the inlet and outlet is found 300 K and 313.7 K, respectively during the simulation. The pressure drops from the inlet side to the outlet side as well a result that raising the temperature, heat coefficient, thermal conductivity, and viscosity of the base fluids when Al<sub>2</sub>O<sub>3</sub> nanoparticles are added.

## "EPITOPE PREDICTION IN MEMBRANE PROXIMAL REGION OF ENVELOPE PROTEIN OF SARS-COV-2"

Urooj Irshad

**A**bstract: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has caused a global pandemic in recent times. SARS-CoV-2 is an enveloped beta-coronavirus. Epitope prediction against viruses for subunit vaccine development using immunoinformatic approaches is becoming a common practice. Currently available vaccines are designed against entire proteins. However, in present study, membrane proximal domain/region of enveloped protein, which includes Transmembrane (TM) and C terminal domain (CTD) of the Delta variant was targeted for their potential immunogenic responses. Proteomic Sequences for the domain for the years 2020-2022 were retrieved and subjected to conservation and mutational analyses. Their physio-chemical characteristics were also determined. The epitopes for T Cell, B Cell, and cytotoxic T lymphocyte were predicted and checked for allergic properties Phosphorylation & glycosylation sites were determined. Secondary and tertiary structural conformations were predicted and screened for potential cleavage sites. Finally, a vaccine construct was designed using the selected peptides based on their best antigenicity, immunogenicity, conservation, and physiochemical properties. A total of 102 residual substitutions were found, including 3, 4, and 95 for the sequences of years 2020, 2021, and 2022 respectively. The residual and atomic composition of domains sequences were analyzed. These conserved and potential antigenic epitopes were then combined to create a vaccine construct, which can be used independently or alongside some other subunit/peptide cocktail formulation to address the challenges associated with using whole protein regions of the virus or mRNA-based vaccines.

## INSILCO ANALYSIS OF SARS-COV-2 VARIANTS CIRCULATING ACROSS THE GLOBE

Masooma Raza

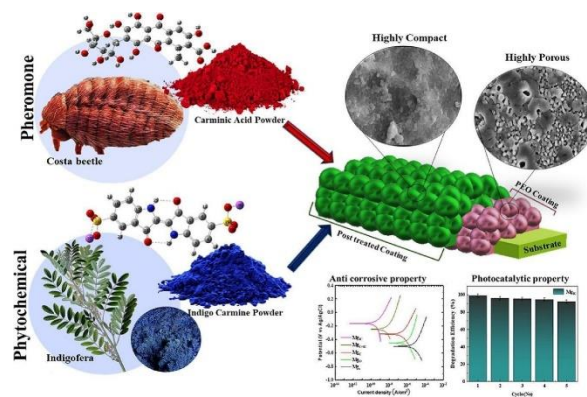
**A**bstract: The coronavirus disease appeared in Wuhan China in 2019 and the disease outbreak a huge global challenge. There are four structural proteins required for the production of mature virus. These polyproteins are further giving rise to 16 different non-structural proteins. In this study principle is the computational analysis of Sever Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) Whole Genome Sequences (WGSs) from China, Pakistan, and India. Total 54 WGS of SARS-CoV-2 were downloaded from National Center for Biotechnology Information (NCBI) databank of which 20 whole genome sequences were from China, 9 were from Pakistan and 25 whole genomes were from India. Alignment showed 36 conserved regions among these 54 nucleotide sequences and showed very less divergence. These conserved sequences have numerous point mutations, 46 substitutional mutations and 10 variable regions on different sites. Alignment showed similarity of 97% among these 54 Whole genome nucleotide sequences. In this study the percent identity of WGSs from China was found to be 93%

whereas the percentage of similarity matrix was also above 93%. WGSs from Pakistan showed the highest similarity and identity percent of 96% whereas WGSs from India had more than 93% similarity and identity percentage. Phylogenetic analysis revealed that the isolates had adjacent evolutionary relationships with its neighboring countries and different samples fall in different clusters of different countries and these isolates shared the same ancestor. Phylogenetic analysis clearly described that isolates from India, China and Pakistan shared the same ancestor as these countries are geographically neighbors. For SARS-CoV-2 omicron and delta variant protein sequence analysis was performed 3D visualization analysis, Z- Score estimate of the generated model, local quality comparison with the PDB structure and local quality estimation was created using SWISS-MODEL. The comparative analysis of proteins between two variants Delta and Omicron have shown that Spike, Nucleocapsid, Envelop and Membrane proteins does not show any visible conformational change in 3d structure, local quality estimate and PDB structure. And comparison between the proteins showed that omicron and delta structural proteins have shared a different model Z-Score and QMEAN, except the membrane protein which shared identical values QMEAN = (-1.23) in the both variants.

**CHROMOPHORES ASSISTED PHYTOCHEMICALS AND  
PHEROMONES COATINGS ON POROUS INORGANIC LAYERS FOR  
ENHANCING ANTI-CORROSION AND PHOTOCATALYTIC  
PROPERTIES**

Tehseen Zehra

**A**bstract: This work aims to enhance the anti-corrosion and photocatalytic activity of porous inorganic layers through a novel approach involving the exploitation of chromophores derived from phytochemicals and pheromones. Herein, organic acid (carminic acid) and organic salt (indigo carmine) obtained from pheromones and phytochemicals, respectively, are utilized to modulate the porous surface of inorganic layers produced on AZ31 Mg alloy via plasma electrolytic oxidation. Such pheromones and phytochemicals coatings have a double link inside them along with negatively charged functional groups, which enabled the sealing of the sponge-like structure of the inorganic layer through a couple of bonding mechanisms, such as hydrogen bonding,  $\pi$ - $\pi$  interaction, as well as electrostatic interactions between polar parts of such organic molecules and cationic species generated from the inorganic layer. The phytochemical coating exhibited superior electrochemical stability compared to other samples, as demonstrated by its high polarization resistance ( $1.27 \times 10^8 \Omega \cdot \text{cm}^2$ ). Additionally, the phytochemical coating demonstrated the ability to photodegrade methylene blue, achieving a photocatalytic efficiency of 99.47 %. The stacked and parallel interactions of the phytochemical and/or phermonic layer on the surface of inorganic layers were explored with the aid of density functional theory.



## ASSESSMENT OF IRON DEFICIENCY IN THE POPULATION OF LAHORE PUNJAB, PAKISTAN

Ahmad Hussain

Department of Zoology, Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: Iron deficiency anemia is known to be the most common nutritional deficiency worldwide and in developing countries including Pakistan. About a quarter of world's population is affected to some degree with the deficiency of iron. In Pakistan 50% of the adolescent females suffer from iron deficiency, while in males it is less severe. Children with dietary preferences also suffer from the anemic conditions. To assess the iron deficiency due to anemia and dietary reasons, the data of 200 subjects was collected from Punjab Pakistan, of which 60 subjects were healthy controls while 140 had abnormal value of serum iron. The analysis of serum iron was performed in clinical diagnostic lab using spectrophotometric analysis followed by calculation of total bound and free iron. The results obtained were analyzed. It was observed that iron deficiency was not only related to dietary issues, lack of exercise but also may be congenital. It was concluded that iron deficiency is also dependent on physiological conditions including pregnancy and post pregnancy period, infection as observed in subjects with co-infected with hepatitis. Iron deficiency conditions can be reversed by adopting healthy and hygienic life style and by incorporating iron rich food in our daily diet.

## CALCIUM AND VITAMIN D DEFICIENCY STUDIES IN THE POPULATION OF LAHORE PUNJAB, PAKISTAN

Hamza Mudassar

Department of Zoology, Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: Calcium as well as vitamin D is crucial for bone health. Their deficiency may lead to weak bones by lowering the density of bones. It is alarming sign for patients. Healthy life style and adequate diet can control further complications. The aim of our study aims to assess the frequency of Vitamin D and Calcium deficiency in local population of Punjab Pakistan. The data was collected from clinical diagnostic lab. A total of 210 subjects were used out of which 65 were healthy controls and 145 were affected with vitamin D and Calcium deficiency. The vitamin D deficiency was evaluated using automated Chemiluminescence

Microparticle Immunoassay (CMIA) method while serum calcium was assessed using spectrophotometric analysis. It was observed that the subjects with indoor activities were more affected with than those exposed well to sunlight. In addition, the persons on diet poor in vitamin D were also affected. Similarly, the subjects on diet poor in calcium as well as in Vitamin D were affected with Calcium deficiency. The percentage of affected females was greater than males due to difference in life style and dietary habits. Both these deficiencies are not only related with each other but also can be controlled using similar remedies including diets rich in calcium and Vitamin D.

### **STUDY OF STRUCTURAL AND ELECTRICAL PROPERTIES OF GADOLINIUM SUBSTITUTED T- TYPE HEXAGONAL FERRITE**

Haider Ali

**A**bstract: The sol-gel auto combustion method was used to prepare T-type hexagonal ferrite  $Sr_{2-x}Gd_xFe_8O_{14}$  having concentrations of  $Gd^{3+}$   $x=0, 0.05, 0.1, 0.15,$  and  $0.2$  which sintered at  $1100^\circ C$  for 3 hours. All the samples exhibited a single-phase structure according to the X-ray diffraction study. By using the XRD patterns, the values of unit cell parameters  $a$  ( $\text{\AA}$ ),  $c$  ( $\text{\AA}$ ) and unit cell volume ( $\text{\AA}^3$ ), crystalline size  $S$ (nm), and dislocation density 'D' were calculated. The values of  $a$  and  $c$  decreased as the Gd content increased. The unit cell volume also decreased with the increase in the concentration of Gd. The Crystalline size varied between 47.25 and 49.34 nm. The dislocation density was decrease in the range of 4.4 to 4.1. The prepared samples showed electrical polarization was due to space charge polarization. The loop showed a concave shape which exhibited intrinsic ferro electrical behaviour. The polarization vs Electric field loop revealed that the lossy behaviour decreased with the substitution which indicates the enhancement of conductivity. The prepared samples were suitable for dielectric applications and capacitors.

### **COMPARATIVE STUDY OF IMPACTS OF DAP AND NATURAL FERTILIZERS ON MAIZE.**

Muhammad Azhar

Department of Botany, Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: Food is very important in human and animal life. It helps for the growth and development. Maize is an important crop in the world and is used for different purposes. It is used as a cereal as well as fodder of livestock. It is used in fast food, popcorns and salad formation. Corn flour is used in manufacturing of variety of bakery items. It is also a source of water, protein, sugar, carbs and other nutrients. I worked on the different fertilizers to know the effect on the growth of Maize. Organic Fertilizer (Compost), DAP and control group were used for the experiment. I used Maize for my research purpose. My research work was of 80 days. Variety of maize used for research was Maize (P1429) because they grow better and fast. This variety of Maize was grown in summer season (March to June). My experiment was of 80 days in three phases. First phase was (1 to 26) days, second was (27 to 53) and third phase (54 to 80) days.

In first phase (1 to 26) days, all seeds were put in petri dishes. Organic fertilizer (compost) and DAP was added in petri plates. Growth of seeds in Organic Fertilizer (Compost) was maximum than DAP and Control group. Temperature and humidity was measured for the effective growth of maize. In second phase (27 to 43) days, all plants were transferred to pots. In this phase, temperature was high and growth was minimum because temperature was inversely proportional to growth. Growth of maize was good in Organic Fertilizer (Compost) than DAP and Control group. In third phase (54 to 80) days, growth was maximum because humidity was maximum. Humidity is directly proportional to growth. Growth of maize was maximum in Organic Fertilizer (Compost) than DAP and Control group. In my point of view, Organic Fertilizer (Compost) was best and beneficial for human health than DAP and Control group. Organic Fertilizer (Compost) showed better effects as compared to DAP on growth of maize.

## **COMPARATIVE STUDY OF IMPACTS OF DAP AND NATURAL FERTILIZERS ON SUNFLOWER.**

Mughees Ahmad

Department of Botany, Government Islamia Graduate College Civil Lines Lahore Pakistan<sup>1</sup>

**A**bstract: Healthy food is basic need of every human being. By adopting natural means of cultivation and organic fertilizers, we can get best quality of food and crop yield. My aim of research was to check the effects of different fertilizers on sunflower growth. Sunflower is not only an ornamental plant. It has many beneficial effects on human health. Sunflower oil improves skin health and promotes cell regeneration. It helps to prevent cancer such as colon cancer. Sunflower oil contains phytosterols to help lower cholesterol. Sunflower oil improves gastrointestinal health. It is very effective in cure migraine. Keeping all these perspective in mind, we can't compromise on health. In my research work, I compared organic fertilizer with DAP and control group. Whole experiment was of 60 days. My experiment was of three phases. In first phase (1-20) days, sunflower seed were grown in petri plates. Organic fertilizer and DAP was added in petri plates. Growth of sunflower seed was maximum in organic fertilizers than DAP and control group. Humidity and temperature was also measured to check their effects in seed germination rate and overall growth pattern in petri plates. In second phase (21-40) days, all the plants were transferred to pots. In this phase humidity was maximum, so the growth rate of sunflower was maximum. The reason was that growth is directly proportional to humidity. In this second phase growth of sunflower was better in organic fertilizer than DAP and control group. In the third phase (41-60) days growth was minimum because temperature was maximum. Growth of sunflower was inversely proportional to temperature. In my research point of view, organic fertilizer (compost) showed maximum growth of sunflower yield as compared to DAP and control group. Organic fertilizers also had positive effects regarding health.



## INTELLIGENT SURVEILLANCE SYSTEM FOR REAL-TIME DETECTION AND RECOGNITION OF UNAUTHORIZED INDIVIDUALS (CAMEYE)

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**A**bstract: This paper presents the development of "Cam Eye," an intelligent surveillance system designed for real-time detection and recognition of unauthorized individuals. The system leverages Convolutional Neural Networks (CNNs) and computer vision techniques to accurately identify faces, using the VGGFace2 dataset for training. By integrating high-definition cameras, the system continuously monitors designated areas, detecting unauthorized access and triggering immediate alerts. The mobile application, built using the Flutter framework, facilitates seamless operation on both Android and iOS platforms, providing real time notifications and user interaction. Firebase is employed as the backend solution, managing data storage, user authentication, and the delivery of alerts, ensuring that the system remains responsive and reliable. Cam Eye aims to enhance security by automating the recognition of unauthorized individuals and enabling swift responses through the mobile app. The system has been rigorously tested in various lighting conditions and environments, demonstrating high accuracy in facial recognition and minimal false positives. Its design emphasizes scalability and integration with existing security infrastructures, making it suitable for deployment in corporate offices, research facilities, and other high-security areas.

**Keywords:** Real-Time Detection, Face Recognition, Surveillance System, Convolutional Neural Networks, Computer Vision, Flutter, Firebase, Security Automation

## VIOLENCE AGAINST WOMEN DETECTION AND EXPLORATION TOOLS USING DEEP LEARNING

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**A**bstract: Addressing the daily violence against women globally, enhancing personal safety and social stability, requires advanced solutions. One approach is a deep learning-based surveillance system that automatically detects and alerts authorities to violent activities. This system first identifies human presence in video frames, then isolates frames with suspected violence, and finally uses a pre-trained MobileNet model for accurate violence detection. The detected incidents are captured as enhanced images, highlighting faces and providing details like time and location. Alerts are sent to authorities via email or messaging apps. This approach leverages Convolutional Neural Networks (CNNs) and MobileNetV2 for efficient and accurate detection.

**Keywords:** Deep learning, MobileNetV2, CNNs, Violence against women, Multimedia analysis, Image Processing, Privacy protection

## PREDICTION OF CROP DISEASES FOR IMPROVING FOOD SECURITY

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**A**bstract: This project, "Prediction of Crop Diseases for Improving Food Security," tackles the significant challenge of reducing the impact of crop diseases on agricultural productivity. By focusing on the early detection of diseases in three essential crops corn, rice and potato we leverage machine learning to enhance intervention strategies and support food security. A robust classifier model was developed using the MobileNetV2 architecture, trained on a dataset of over 6770 images, covering diseases like Common Rust, Gray Leaf Spot and Northern Leaf Blight in corn; Bacterial Leaf Blight, Brown Spot and Neck Blast in rice and Early Blight, Late Blight and a healthy class in potato. The model achieved a testing accuracy of 98.68%, showcasing its effectiveness in disease identification. To ensure accessibility, we created a mobile and web application with an intuitive GUI using Flutter, providing farmers with a reliable tool for timely and accurate disease prediction. The app facilitates better crop management through features like diagnostic feedback, disease information, treatment suggestions and historical data analysis. By integrating predictive analytics, the app offers personalized advice and alerts users to potential outbreaks, enabling proactive measures for healthier crops and enhanced food security. This project demonstrates the potential of technology to transform agriculture, contributing to more sustainable and resilient food production systems.

**Keywords:** Crop Disease Prediction, Machine Learning, MobileNetV2, Agriculture Technology, Food Security

## IMPROVING ROAD SAFETY IN PAKISTAN USING ARTIFICIAL INTELLIGENCE

### (ROAD SAFE VISION)

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**A**bstract: This research project focuses on improving road safety in Pakistan by utilizing Artificial Intelligence (AI) to address the high rate of accidents caused by traffic violations, poor infrastructure, and inadequate emergency response systems. The proposed solution integrates AI techniques such as computer vision and machine learning to develop a comprehensive approach comprising real-time traffic monitoring, predictive analytics for identifying accident-prone zones, and automated emergency response systems. Real-time monitoring will detect traffic violations like overspeeding and signal breaches, alerting authorities for prompt action. Predictive models will analyze historical data to identify high-risk areas, enabling targeted improvements and policy changes. Additionally, AI-driven emergency response systems will detect accidents swiftly and dispatch emergency services, significantly reducing response times. This research aims to provide valuable insights and tools for policymakers, traffic management authorities, and urban planners to enhance road safety, reduce accidents, and save lives in Pakistan.

**Keywords:** Road Safety, Artificial Intelligence, Traffic Monitoring, Predictive Analytics

## **HHO GAS AS A FUEL AND ITS GENERATOR: A COMPRESSIVE STUDY**

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**A**bstract: This study focuses on designing and optimizing a Hydrogen-Hydrogen-Oxygen (HHO) generator to enhance fuel efficiency in internal combustion engines. HHO gas, produced through electrolysis, improves the combustion process by increasing energy output per unit of fuel and reducing emissions. Although HHO generators are already in use, limited research has been conducted on optimizing their efficiency. Our experiments involved testing an optimized HHO generator on a CD 70 motorcycle, resulting in a 15-20% increase in fuel efficiency and a 50% reduction in exhaust emissions. Graphs depicting these results provide insights into the generator's performance under various conditions, demonstrating its potential for broader applications in sustainable energy solutions.

## **INFLUENCE OF $\text{Sm}^{+3}$ SUBSTITUTION ON THE THE STRUCTURAL, MAGNETIC AND ELECTROCHEMICAL PROPERTIES OF M-TYPE SR HEXAFERRITES FOR SUPERCAPACITOR APPLICATIONS**

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**A**bstract: In this project, samarium-substituted strontium hexaferrites with the formula  $\text{SrSm}_x\text{Fe}_{12-x}\text{O}_{19}$  (where  $x$  ranges from 0 to 0.5) were synthesized using the sol-gel auto-combustion method. The resulting powders were then sintered at  $1200^\circ\text{C}$  for 2 hours. The various properties of the samples, including structural, functional group, morphological, elemental, optical, magnetic, dielectric, and electrochemical characteristics, were examined using X-Ray diffractometer, Fourier transform infrared spectroscopy, scanning electron microscopy, Energy dispersive X-Ray, UV-visible, vibrating sample magnetometer, Inductor capacitor and resistor meter, and cyclic voltammetry, galvanostic charging and discharging. The structural analysis confirmed the formation of a single-phase Magnetoplumbite structure in all samples. The crystallite size decreased with an increase in  $\text{Sm}^{+3}$  ion concentration. The presence of characteristic bands in the range of  $400\text{-}760\text{ cm}^{-1}$ , corresponding to metal-oxygen stretching and vibrational bonds, was observed. The bandgap increased from 4.26 to 4.40 eV. The magnetic properties exhibited a clear ferromagnetic M-H curve, with the coercivity value increasing and the saturation magnetization decreasing. The dielectric constant and tangential loss of the material both decreased with increasing frequency, while the AC conductivity increased with applied frequency. This behavior is typical of ferrites and can be attributed to the polarization and orientation of dipoles within the material in response to an electric field. The observed increase in dielectric

constant at higher frequencies suggests that the material could be useful in high-frequency electronic devices. The specific capacitance increased monotonically up to 167 F.g-1 with increasing  $\text{Sm}^{+3}$  concentration, making the samarium-substituted hexaferrites suitable for high-energy-density charge storage devices such as supercapacitors.

## **SUPERIOR FUNCTIONAL AND ELECTROCHEMICAL DETECTION OF BADDELEYITE ( $\text{ZrO}_2$ ) FOR NOVEL SUPERCAPACITORS SLURRY ELECTRODES**

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**A**bstract: The zirconia (zirconium dioxide) is fabricated using solid state sintering technique. The XRD and their refinement data declare the proper growth of  $\text{ZrO}_2$  materials. The modest value X2 (goodness of fit 1.558) shows that proper symmetrical formation of crystal. The XRD pattern shows the single symmetrical formation of baddeleyites. The different parameters like lattice constant, angle beta, atomic sites, wyckoff position and R-profile components are obtained from software. There is no secondary peak and distortion is elucidated. The diamond software shows the seven-fold of cations linkage present in  $\text{ZrO}_2$  symmetry. The clear monoclinic grain formation without any stacking is observed in SEM analysis. The characteristic stretching and bending vibration of metal ions between  $503\text{-}617\text{ cm}^{-1}$  is identifying the single zirconia phase with FTIR analysis. The specific capacitance 502, 432, 347, 316 and 262 F/g are observed at 10,20,30,40 and 50 mVs-1 respectively utilizing the Cyclic Voltametric data. These values cross matched with the charging and discharging (GCD) and electrochemical impedance spectroscopy (EIS) analysis. It is found in the range of 546-282 F/g in GCD while for EIS it is observed in the range of 487-254 F/g which can be used as novel walnut shells bas slurry electrode production, especially for supercapacitors working electrode.

## **BISMUTH OXIDE THIN FILMS DOPED WITH IRON FOR MULTIPURPOSE USES: SYNTHESIS AND APPLICATIONS**

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**A**bstract: Metal oxide thin film is a useful tool for scientists because of its many uses in electrical device performance, environmental remediation, materials development, and transdisciplinary research. For the research, iron-doped bismuth oxide ( $\text{Bi}_2\text{O}_4$ ) thin films were prepared using the dip-coating process. X-ray diffraction spectra were used to confirm that all thin films included the monoclinic  $\text{Bi}_2\text{O}_4$  phase. The functional bonds of bismuth oxide were confirmed using Fourier transform infrared spectroscopy in the around  $460\text{-}580\text{ cm}^{-1}$  range. It was discovered that the bandgap of both undoped and Fe-doped  $\text{Bi}_2\text{O}_4$  films was between 2.0 and 1.80 eV. This range was necessary for the Fe:  $\text{Bi}_2\text{O}_4$  films to be employed as window layers in solar cells. Iron-doped  $\text{Bi}_2\text{O}_4$  exhibits superior photocatalytic performance in comparison to undoped  $\text{Bi}_2\text{O}_4$ , most likely due to improved charge separation and transfer. When organic

pollutants are exposed to visible light, this speeds up their disintegration. In order to enhance the photocatalytic properties of  $\text{Bi}_2\text{O}_3$ , further research is required to ascertain the ideal doping concentration and explore diverse methodologies. The results of the study indicate that iron-doped  $\text{Bi}_2\text{O}_3$  holds great potential for applications in environmental remediation and water purification. By providing a practical and economical approach to water treatment, this material aids in the accomplishment of sustainable development goals.

## ELECTRODES WITH A HIERARCHICAL HETEROSTRUCTURE OF METAL OXIDES/MXENE

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**A**bstract: Recent efforts have focused on studying complex heterostructured nanomaterials, which perform better electrochemically than single-structured materials. The ternary hybrid electrode material made of MXene and Cerium Oxide ( $\text{CeO}_2$ ) is described in this study. The material was synthesized hydrothermally by aniline in situ polymerization. At a current density of  $2 \text{ Ag}^{-1}$ , the ternary hybrid electrode material has shown remarkable cyclic stability, an extraordinary coulombic efficiency of 91%, and a specific capacitance of  $2250 \text{ Fg}^{-1}$ . Our work improves SDGs 7 (Affordable and Clean Energy) and 13 (Climate Action) through the development of energy storage technology and offers prospects for practical use in low-cost, eco-friendly energy storage systems.

## MANAGING THE MICROSTRUCTURE AND PROPERTIES OF THE GOLD DOPED ZNO NANOSTRUCTURES VIA AU DOPING

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**A**bstract: Gold (Au) doped ZnO nanostructures were synthesized at room temperature by sol gel dip coating method. Nanostructures were annealed at optimized temperature. The properties of Au- ZnO nanostructures were characterized by Fourier transform infra red spectroscopy (FTIR), X- RAY Diffractometer (XRD), Scanning electron microscope (SEM) as well as UV-VIS-NIR spectrophotometry. XRD revealed the hexagonal wurtzite structure of ZnO. The crystallite size was determined to be 25.01nm. The optical characteristics of Au-ZnO nanostructures were inspected through UV-VIS-NIR spectrophotometry. By FTIR analysis, the chemical composition of ZnO nanostructures doped with Au was examined. Transparency as well as changes in the optical band gap were observed in optical studies as the percentage of Au doping increased. The surface morphology and roughness of the nanostructures were affected by the Au doping. Agar well diffusion was used to test the Au-ZnO antibacterial activity in order to better understand its biological characteristics.

## **ION ACOUSTIC WAVES IN GENERALIZED ELECTRON DISTRIBUTION MAGNETIZED PLASMAS: AN EXAMINATION EMPLOYING THE REDUCTIVE PERTURBATION METHOD**

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**A**bstract: Theoretical plasma physics is needed to address common issues such as Climate Action (13), as well as Affordable and clean energy (7). Developing theoretical models into practical solutions is essential to achieving the Sustainable Development Goals (SDGs) and fostering inclusivity. Multidisciplinary cooperation and creative research methods are required for this. The formation of solitary waves, or solitons, in a plasma medium is described by the Zakharov-Kuznetsov-Burgers (ZKB) equation, a nonlinear partial differential equation in plasma physics. It is essential for the development of technologies that employ plasma for energy conversion and generation, such as fusion reactors and plasma-assisted combustion systems. The ZKB equation aids in the understanding of plasma dynamics, which is crucial for energy generation and conversion technologies. Ion acoustic waves (IAWs) in magnetized plasmas are studied using the reductive perturbation method (RPT), which allows researchers to examine electron distributions, plasma characteristics, and KdV-B equations in the Earth's magnetosphere. Space exploration, technological development, and environmental monitoring are the three primary fields of research. The effects of electron flatness at low energies and superthermal at high energies are investigated. The small-k perturbation method is applied to IAWs in order to determine the growth rate and instability threshold. This effort enhances sustainable space technology and ion acoustic systems in space plasma.

## **ALFVEN WAVES AND SPACE WEATHER**

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**A**bstract: Alfvén waves, a fundamental plasma wave phenomenon, play a crucial role in space weather dynamics. These waves propagate along magnetic field lines in the ionized plasma of the solar wind and magnetosphere, significantly influencing the space environment around Earth. This presentation explores the connection between Alfvén waves and space weather, highlighting how these waves contribute to various space weather phenomena such as solar flares, coronal mass ejections, and geomagnetic storms. Understanding these phenomena are essential for predicting space weather impacts on satellite operations, communication systems, and power grids on Earth.

## SILVER BASED SILICA MEMBRANES FOR DESALINATION

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**A**bstract: This study explores the development of silver-doped silica membranes for water desalination and antibacterial applications. Using the sol-gel technique, we created membranes with enhanced hydrophobicity and antibacterial properties, confirmed by SEM, EDX, FTIR, and UV analysis. The membranes demonstrated significant water rejection and bacterial inhibition, making them effective for water purification and healthcare. Environmental sustainability was also considered, with proposed strategies for membrane reuse. These findings highlight the potential of silver-doped silica membranes in improving water treatment systems and contributing to public health.

## TAILORING ZEOLITE-COMPOSITE (ZC) IMPREGNATED NONPOROUS MEMBRANES FOR POTENTIAL GAS SEPARATION AND ANTIBACTERIAL PERFORMANCES

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**A**bstract: Cellulose acetate (CA) composite membranes are tailored for potential gas-transportation and antibacterial activity by incorporating various ratios (0-8wt. %) of zeolite- CuO (10:1, ZC) composite. The aim behind this is to develop an anti-biofouling membrane with enhanced CO<sub>2</sub> permeation and selection properties. In situ coprecipitation route is adopted to synthesize ZC that imparted morphological, structural, thermal, and performance characteristics of membranes synthesized by solution casting mechanism. FESEM analysis revealed, pores size transformed from 1 $\mu$ m to 1.4 nm as observed in M0 (virgin) and M4 (8wt. % ZC) membranes, respectively. The existence and linkages of impregnated ZC in the developed membranes are verified by FTIR investigations. TGA-tested thermally endured membranes are tested for gas permeation/selectivity. In comparison to virgin CA membrane, three folds enhancements in CO<sub>2</sub> permeation and two folds in CO<sub>2</sub>/N<sub>2</sub> selectivity are observed. Membranes are also evaluated for antibacterial test against 'gram- negative bacteria' elucidates that increasing ZC content in composite membranes exhibit remarkable results.

## ELECTROCHEMICAL CORROSION STUDY OF CH-XTIO<sub>2</sub> (X=AG, MG, SR, AND ZN) COATED TI-6AL-4V ALLOY FOR DENTAL IMPLANT

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**A**bstract: Ti-6Al-4V is a widely used material for dental and orthopedic implants due to its biocompatibility and excellent mechanical properties. However, it is susceptible to corrosion when exposed to the human body and oral environment. To alleviate this issue

and enhance and improve its application in dentistry, we applied a protective coating to the alloy surface. Thin films of CH-xTiO<sub>2</sub> (x=Ag, Mg, Sr, and Zn) composites were deposited on titanium alloy substrates using the sol-gel dip coating technique. Coated and uncoated substrates surface roughness and morphology were analyzed using profilometry, SEM, and AFM. The results revealed that the coating effectively protects the alloy surface. Corrosion protection in artificial saliva was evaluated through potentiodynamic polarization (Tafel), electrochemical impedance spectroscopy (EIS), and cyclic voltammetry (CV) studies. The results indicate that the CH-xTiO<sub>2</sub> coating significantly improves the corrosion resistance of titanium alloy surfaces in artificial saliva, enhancing the durability and performance of dental implants in challenging oral environments and thus increasing patient satisfaction.

## **SYNTHESIS AND CHARACTERIZATION OF CERAMICS IN (CAO-MGO- SiO<sub>2</sub>) SYSTEM WITH COPPER OXIDE ADDITIVES.**

Sana Shahzadi<sup>a</sup>, Madeeha Riaz<sup>\*,a</sup>

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**A**bstract: The main focus of research was to enhance the different physical, Dielectric and optical properties of diopside. This study is an effort to contribute in development of biocompatible composites. In present study five different metal (Cu)-ceramic based composites named as x=0.03% Cu, 0.06%Cu, 0.09%Cu, 0.12% Cu and 0.15%Cu were prepared by solid state sintering method. The XRD showed presence of one phase of Diopside (ICDD no. #86-0932) and a liquid phase of copper was also observed. SEM indicates that copper does not make the solid phase with it makes a Cu<sub>2</sub>O-rich eutectic liquid phase it also confirms the phase transition from C2/c to P21/c at 0.06% of CuO .The FTIR also proved the XRD as it shows that O-Mg-O bond in the diopside start vanishing with the increase of copper doping as the copper makes it Mg deficient. The bioactivity analysis confirms the apatite layer formation and the optical analysis showed that the copper doped diopside shows the sharp absorbance at 287.82 wavelengths this doping also degenerates the microwave dielectric properties. It shows that CuO enhance the ability of the material the doped diopside can be used for microwave communication, and also the best use of this is in medical and bone replacement.

## **CEO<sub>2</sub> /CE<sub>2</sub> S<sub>3</sub> NANOCOMPOSITE: A NOVEL CATALYST FOR EFFICIENT PHOTODEGRADATION OF ORGANIC DYES**

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**A**bstract: Hydrothermal technique was used to prepare CeO<sub>2</sub> , Ce<sub>2</sub> S<sub>3</sub> and CeO<sub>2</sub> /Ce<sub>2</sub> S<sub>3</sub> composite. XRD was used to characterize the fabricated samples. The manufactured samples morphology is investigated using SEM technique. The purpose of photocatalytic degradation was to assess the catalytic performance of synthesised samples.



According to the results of photocatalytic activity, rose bengal dye was degraded 94.8% in the presence of catalyst (CeO<sub>2</sub>/Ce<sub>2</sub>S<sub>3</sub> composite) and UV-visible light, while less than 13% of the dye was degraded after 120-minutes in the absence of photo catalyst. In contrast, the percentage of degrading dye decreased when catalyst was absent. When exposed to UV-Visible radiation, the CeO<sub>2</sub>/Ce<sub>2</sub>S<sub>3</sub> composite exhibited more photo degradation (94.8%) with rose bengal dye than CeO<sub>2</sub> (84%) and Ce<sub>2</sub>S<sub>3</sub> (71.2%). Because photocatalysis is dependent on the band gap energy, the band gap caused a greater percentage of degradation of composite materials. The effects of increasing time demonstrate that the catalyst of CeO<sub>2</sub>/Ce<sub>2</sub>S<sub>3</sub> composite exhibits a linear relationship. As time goes on and more light energy strikes the catalyst surface, more photoexcited species arise and photocatalytic activity is developed. Using the Tauc relationship, the band gap energy for a CeO<sub>2</sub>/Ce<sub>2</sub>S<sub>3</sub> composite may be determined. The rate of degradation constant for the photodegradation reaction was found, indicating that it followed the principles of a pseudo-first-order kinetic reaction.

## A STUDY ON SYNTHESIS AND CHARACTERIZATION OF NON-STOICHIOMETRIC HARDYSTONITE (Ca<sub>2</sub>ZnSi<sub>2</sub>O<sub>7</sub>) FOR OPTICAL AND DIELECTRIC APPLICATIONS

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**A**bstract: Hardystonite (Ca<sub>2</sub>ZnSi<sub>2</sub>O<sub>7</sub>) was prepared using non-stoichiometric composition by solid-state method at 1200 °C. Structural analysis revealed that Hardystonite (Ca<sub>2</sub>ZnSi<sub>2</sub>O<sub>7</sub>) as a major phase and Wollastonite (CaSiO<sub>3</sub>) as a minor phase for all samples with no other impurity peak. Morphological analysis revealed irregular agglomerated morphology with a particle size of 323 μm. The optical band gap ranges from 4.48 to 5.0 eV suitable for sensors, bolometers, and optoelectronic applications. Dielectric constant (3.4-7.7), Resistivity (2.6 × 10<sup>-8</sup> -4.5 × 10<sup>-7</sup> Ωm), and AC conductivity were found at 2.1 × 10<sup>-7</sup> -3.8 × 10<sup>-7</sup> Sm<sup>-1</sup>, making it suitable for Low temperature co-fired (LTCC) applications.

## INVESTIGATION OF ELASTO-MECHANICAL PROPERTIES OF LUNISB USING DFT

Muhammad Shahzad,

**A**bstract: In this research work we implemented density functional theory as encoded in Wien2K to calculate the Structural, Elastic and Mechanical Properties of LuNiSb (Half Heselur Alloy). We evaluated the Structure and Elastic properties of material using Perdew-Burke-Ernzerhof Generalized Gradient Approximation (PBE-GGA) as exchange correlation functional. The lattice constants and the ground state energies of the given material are found to be in good agreement with the experimental results. The elastic parameters  $C_{11}$ ,  $C_{12}$ ,  $C_{44}$  of LuNiSb were also comparable with other available theoretical and experimental results. These elastic parameters are then used to assess the mechanical characteristics comprising of the Shear modulus(G), Bulk modulus(B), Young's modulus(E), Pugh's ratio(B/G), Poisson's ratio (ν) and

Anisotropic ratio (A). After examining each factor, we estimated various mechanical characteristics of the material. We expect that this evaluation will be useful for industrial purposes.

## AGE OF AI

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**A**bstract: The term "Age of AI" refers to a critical period in which artificial intelligence has a substantial impact on daily lives, economies, and industries. The benefits of AI are considerable; it can evaluate large amounts of data rapidly and with speed and precision. These skills foster innovation in a variety of industries, including finance, healthcare, and transportation, which improves results and lowers costs while facilitating better decision-making. AI has the potential to address global issues like disease control and climate change. However, there are several significant drawbacks to AI's emergence. There is a compelling need to address ethical issues such as algorithmic unfairness, data privacy abuses, and the perpetuation of social inequality. There are societal and economic worries about the possible automation-related job displacement. Furthermore, there are serious concerns associated with the misuse of AI in fields like military applications and spying.

## FUNDAMENTALS, APPLICATIONS, AND IMPACT ON PHYSICS

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**A**bstract: Artificial Intelligence (AI) is rapidly transforming various fields, from self-driving cars to personalized medicine. This presentation explores the fundamentals of AI, focusing on key areas such as machine learning, deep learning, natural language processing (NLP), and computer vision. It delves into different machine learning algorithms, including supervised, unsupervised, and reinforcement learning, and discusses the structure and function of neural networks, particularly feedforward, recurrent, and convolutional neural networks. Moreover, the presentation highlights AI's applications in physics, such as particle physics, astrophysics, materials science, and quantum computing, where AI plays a crucial role in data analysis, prediction, and modeling. Ethical considerations, including bias, privacy, security, and transparency, are also addressed, underscoring the need for responsible AI development and deployment. This comprehensive overview aims to provide insights into how AI is shaping the future across various domains, with a special emphasis on its impact and potential in the field of physics.

**PSEUDOMEGASPOROPORIA MARGALLENSIS SP. NOV. AND  
MICROPORELLUS SUBADUSTUS (POLYPORACEAE,  
BASIDIOMYCOTA): FIRST REPORT OF THE GENERA FROM  
PAKISTAN**

Fauzia Razzaq\*, Rimsha Murtaza, Muhammad Usman, Abdul Nasir Khalid, Shazia Ashraf,  
Qirui Li

**A**bstract: In the current study, *Pseudomegasporoporia margallensis* is described as a new species, while *Microporellus subadustus* is a new record, collected from Margalla Hills National Park, Islamabad, and Pabbi Park Forest, Gujrat, Pakistan, both these genera are the first reports from the country. These unique species are identified based on morphological features and nrDNA ITS-LSU combined phylogenetic analyses. The *P. margallensis* sp. nov. is characterized by a light brownish gray poroid hymenophore, grayish brown subiculum surface, generative hyphae frequently present in subiculum with abundant clamp-connections, and the presence of arboriform-branched skeletal hyphae in both subiculum and tubes. Detailed descriptions, field, and microscopic photographs of anatomical features are provided.

**Keywords:** Margalla Hills, Phylogeny, Polyporoid fungi, Taxonomy, White-rot

**GEASTRUM ISLAMABADENSIS (GEASTRACEAE,  
BASIDIOMYCOTA), A NEW EARTHSTAR SPECIES OF SECT.  
COROLLINA FROM THE MARGALLA HILLS, PAKISTAN**

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**A**bstract: Specimens of a species belonging to the genus *Geastrum* were collected during a survey of macrofungal diversity in Margalla Hills, Islamabad, Pakistan. Micro-morphological observations and phylogenetic analyses based on internal transcribed spacers (ITS1-5.8S-ITS2) and large subunit of nrDNA (nrLSU) sequences confirmed the taxonomic distinctness of this species. The novel species is characterized by smaller basidiomata, pale-brown pseudoparenchymatous layer of exoperidium, light gray endoperidium enclosing dark greyish black gleba, globose to subglobose basidiospores (3.35–4.78  $\mu\text{m}$  in diam.) and thick-walled capillitial hyphae. The macro- and micrographs along with a detailed description of the new taxa are provided.

**Keywords:** Basidiomycota, Gasteroid fungi, Gleba, Multi-gene phylogeny, Taxonomy

## SYNTHESIS OF COPPER DOPED NICKEL OXIDE THROUGH CO PRECIPITATION METHOD FOR SUPERCAPACITORS APPLICATIONS

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**A**bstract: In this work Copper doped nickel oxide with chemical formula  $Cu_xNi_{1-x}O$  ( $x=0.00, 0.01, 0.03, 0.05$  and  $0.07$ ) have been fabricated using co-precipitation method and sintered at  $500^\circ C$ . The structural, morphological, optical, dielectric and electrochemical properties have been studied by X-ray Diffractometer (XRD), Scanning Electron Microscopy (SEM), UV-visible spectroscopy (UV-Vis), Inductor Capacitor Resistor meter (LCR) and Potentiostat/galvanostat respectively. The structural analysis reveals that nickel oxide exhibits face-centered cubic rock salt structure. The crystallite size of nickel oxide nanoparticles is observed between 10-50 nm. The crystallite size increases with increasing copper concentration. The spherical-shaped nanoparticles with definite boundaries having average particles size ranges from 20-100 nm is observed. The optical properties reveals that band gap energy is reduced with increasing doping concentration of  $Cu^{2+}$  ions. The optical band gap lies in range of 3.5 eV to 4.0 eV. FTIR spectra shows the main Cu-O bond in range of 400-500  $cm^{-1}$  and the Ni-O bond lies in the range of 500-600  $cm^{-1}$ . Dielectric analysis reveals that copper doping enhances the ac conductivity at high frequency. The specific capacitance observed by CV analysis is  $\sim 267 Fg^{-1}$  at  $5mVs^{-1}$

## INVESTIGATION OF STRUCTURAL AND ELECTROCHEMICAL PROPERTIES OF NICKEL TIN SULFIDE BASED COMPOSITES SYNTHESIZED USING HYDROTHERMAL METHOD FOR SUPERCAPACITOR APPLICATIONS

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**A**bstract: The energy crisis is driving the demand for novel and innovative materials for the development of alternative energy sources. Supercapacitors have attracted great attention because of their high power density and long life cycle. In this work, pure nickel tin sulfide  $Ni_3Sn_2S_2$ , binary composite  $Ni_3Sn_2S_2 / rGO$  and  $Ni_3Sn_2S_2 / rGo/PANI$  have been prepared via hydrothermal route. The synthesized materials were characterized by XRD, CV, GCD and EIS techniques and investigated its utilization for electrode materials. XRD analysis demonstrate the existence of constituents and their mutual contribution in all the binary composites and in a ternary hybrid material. Electrochemical results have proven that ternary composites  $Ni_3Sn_2S_2 / rGo/PANI$  electrode exhibits an excellent specific capacitance of 742.6 F/g at a scan rate of 0.5 mV/s among all the prepared composite. Hence, analysis have proved that  $Ni_3Sn_2S_2 / rGO/PANI$  ternary hybrid is beneficial electrode material for the utilization of supercapacitor application

## HYDROTHERMAL SYNTHESIS OF NICKEL MOLYBDENUM SULFIDE-BASED COMPOSITE FOR HIGHPERFORMANCE HYBRID-SUPERCAPACITOR

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**A**bstract: High power and high energy are demanded in escalating applications in hybrid electric vehicles, backup energy devices, uninterrupted power sources, defense and military devices, and many other electrical appliances. The need for energy storage has necessitated extensive study into electrochemical energy storage technologies. Due to their high energy density compared to simple capacitors and high-power density compared to typical batteries, supercapacitors have become one of them and have attracted a lot of attention. This research work represents the synthesis of hydrothermally prepared transition metal sulfides pure NiMoS<sub>4</sub>, CuS, and a novel composite NiMoS<sub>4</sub>/CuS/CNTs and their fabrication of electrodes for supercapacitor applications. The CV manifests that the NiMoS<sub>4</sub>, CuS, and NiMoS<sub>4</sub>/CuS/CNTs electrodes at the scan rate of 5mV/s have specific capacitance values of 266.03 F/g, 126.79 F/g, and 435.8 F/g respectively. Among all electrodes, NiMoS<sub>4</sub>/CuS/CNTs electrode have a greater specific capacitance of 435.08 F/g at 5 mV/s. Through the GCD analysis, NiMoS<sub>4</sub>/CuS/CNTs electrode exhibits higher specific capacitance of 202.53 F/g, compared to 130.86 F/g for CuS and 185.00 F/g for NiMoS<sub>4</sub>, at 0.5A/g, which specifies that the specific capacitance of the ternary hybrid composite material is significantly boosted. The EIS study depicts that NiMoS<sub>4</sub>/CuS/CNTs electrode possess minimum ohmic resistance of 1.08 Ω which attributes to high conductivity and faster redox reaction. The novel ternary composite NiMoS<sub>4</sub>/CuS/CNT electrode is beneficial material in supercapacitor application.

## SILVER SUBSTITUTED COFE<sub>2</sub>O<sub>4</sub>; THE STRUCTURAL, MULTIFERROIC AND ELECTROCHEMICAL PROPERTIES FOR SUPERCAPACITOR APPLICATIONS.

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**A**bstract: Spinel ferrites are important in the field of technologically essential materials. Their excellent electromagnetic capabilities, spinel ferrites are widely employed in a variety of applications, including energy storage devices, high-density magnetic data storage, magnetic resonance imaging (MRI), and medication delivery. They are also employed in ultracompact and adjustable micro supercapacitors (MSCs), which are highly sought after for powering microscale devices in 5G and Internet technologies. Silver doped Co Spinel ferrites with general formula Ag<sub>x</sub>Co<sub>1-x</sub>Fe<sub>2</sub>O<sub>4</sub> were synthesized with variation of dopant concentration (x = 0.0, 0.02, 0.04, 0.06 and 0.8) using Solid state method at sintered at 1100°C for 2h. The structural, optical, dielectric, magnetic and electrochemical properties have been evaluated using X-ray diffractometer (XRD), UV-Visible spectroscopy, Inductor Capacitor Resister (LCR) meter, Vibrating Sample Magnetometer (VSM), Cyclic Voltammetry (CV) techniques respectively. The XRD pattern confirms the formation of the spinel phase of CoFe<sub>2</sub>O<sub>4</sub> and the presence of Ag ions in the spinel structure. The lattice parameter increases due to the replacement of Ag with Cobalt.

The spinel phase  $\text{Ag}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$  nanoparticles are confirmed by FTIR analysis by the major bands formed at 602.9 and 660.41  $\text{cm}^{-1}$ , which represent the tetrahedral and octahedral sites. Magnetic behavior analysis shows that all of the samples exhibit superparamagnetic behavior. Although the as-fabricated pure and doped cobalt ferrite samples exhibit low saturation magnetization and coercivity, they are ferromagnetic in nature. The optical band gap energy falls as the concentration of silver ions increases. The dielectric constant, tangent loss, and AC conductivity were found to vary with frequency and silver content. The Dielectric Constant and Tangent Loss decrease with increasing frequency for all samples. The specific capacitance ( $C_{sp}$ ) of prepared electrodes increases with increasing Ag concentration. The highest  $C_{sp}$  is obtained at  $x = 0.08$  which is  $\sim 1236.7 \text{ F/g}$  at the lowest scan rate of 10mV/s. The pseudocapacitive contribution of the sample at  $x = 0.08$  is 91.49 % at scan rate of 10mV/s. As a result, these electrodes might be considered a good choice for supercapacitors. This research shows a novel strategy for increasing the energy storage capabilities of a particular material.

### **CFD ANALYSIS OF LEAD PARTICLES FILTRATION EFFICIENCY BY USING CYCLONE SEPARATOR**

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**A**bstract: Environmental pollution is an alarming global issue. Different research confirmed that lead is egrigious for human health. The cyclone separators are brilliant devices used for the separation of material particles from fluids. They are widely used in industries for the separation of many solid particles. In this research, the computational fluid dynamics (CFD) technique of ANSYS is used to observe the efficiency of lead particle filtration of a cyclone separator. For this research, the cyclone separator is designed of height of 0.11m with outlet height of 0.0626m, inlet height of 0.151m with depth of 0.11m using ANSYS Fluid Flow. For filtration, the net particles used is ranged from 4  $\mu\text{m}$  to 7  $\mu\text{m}$  with an inlet velocity of 3 m/s. The cyclone separator shows the minimum efficiency of 21.68% for the particle size of 4  $\mu\text{m}$ . The maximum filtration efficiency achieved in this research work is 99.29% for the particle size of 7  $\mu\text{m}$ . These simulations show that the filtration efficiency of the cyclone separator directly depended on the size of the lead particle. This research concluded that the cyclone separator has proved to be an excellent device for the filtration of lead particles from the air.

### **SYNTHESIS OF P2-TYPE CATHODE MATERIALS FOR RECHARGEABLE SIBS**

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**A**bstract: Sodium ion battery (SIB) is promising alternative of lithium ion battery due to abundance source of sodium salt, environment friendly nature and low cost. The most critical challenge for sodium ion battery is development of high capacity and long lifespan of cathodes. This study will focus on advantages of sodium ion battery and synthesized  $\text{Na}_0.5\text{Mn}_0.5\text{Ni}_0.5\text{O}_2$  and  $\text{Na}_0.67\text{Mn}_0.5\text{Ni}_0.4\text{Cu}_0.1\text{O}_2$  to improve the performance and stability

of the cathode materials. XRD analysis investigated the P2-type hexagonal structure of cathode material.  $\text{Na}_{0.67}\text{Mn}_{0.5}\text{Ni}_{0.4}\text{Cu}_{0.1}\text{O}_2$  demonstrated the highest conductivity and it delivered the highest specific capacity of 121.49 mAh/g at 10 mV/s, which showed the best cathode for SIBs.

**STUDY OF ELECTROCHEMICAL AND OPTICAL PROPERTIES OF  
METAL DOPED NiO FOR IMPROVED ELECTROCHROMIC  
PERFORMANCE.**

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**A**bstract In this study electrochemical and optical properties of bare NiO and metal (Mn) doped NiO was synthesized by co-precipitation method with aim of enhancing electrochromic properties. Electrochromic materials have ability to change color in response to an applied voltage. In terms of coloration efficiency and response time, NiO is well known electrochromic material. Doping of transition metals enhances electrochromic performance of NiO. NiO is low cost material allowing good cyclic stability, high coloration efficiency and good durability.