DST-SERB SPONSORED
NATIONAL CONFERENCE ON

# TRANSITION METAL BASED SODIUM ION BATTERIES (SIBS) FOR ULTRAFAST ENERGY STORAGE SYSTEMS -*NCTMSIB'19*

## DEPARTMENT OF SCIENCE & HUMANITIES

## Dr. N.G.P. INSTITUTE OF TECHNOLOGY

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai, Recognized by UGC
Accredited by NAAC & NBA (BME, CSE, ECE, EEE & MECH)
Coimbatore – 641 048

**November 13, 2019**


**Editors**
***Dr. E. Ranjith Kumar***
***Dr. S. Bhuvana***
***Dr. M. Raja***
***Ms. G. Thilakavathi***
***Mr. V. Praveenkumar***



**Organized by**
**Department of Science & Humanities-Physics**
**Dr.N.G.P.Institute of Technology**
**Dr.N.G.P. Nagar, Kalapatti Road**
**Coimbatore - 641 048.**



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# Chairman's Message

*I am very glad to know that the Department of Science and Humanities is organizing DST-SERB sponsored National conference on Transition Metal based Sodium Ion Batteries (SIBs) for Ultrafast Energy Storage Systems on 13th November 2019.*

*Battery Energy Storage (BES) can enable the transition to a sustainable and secure energy system based on renewable sources, with reduced greenhouse gas emissions and enhanced energy independence. Batteries can store energy from on-peak renewable energy and release it when it is more needed, in central, de-centralized and off-grid situations. Batteries can also offer grid support services like voltage control and frequency regulation, so maintaining grid stability and flexibility. Overall, batteries can bolster India's use of renewables, as well as its energy efficiency, sustainability, independence and security. This conference will focus the present and future objectives of Energy Storage Systems and outline the future developments and challenges. I hope the conference may provide a learning platform for young researchers and students to present their research through which they can develop a foundation for collaboration to equip themselves to meet the future challenges.*

*My best wishes to all our delegates and the organizers.*

*With regards,*

**Dr. Nalla G. Palaniswami**

**Chairman**

# Secretary's Message

*I am very glad to know that the Department of Science and Humanities is organizing DST-SERB sponsored National conference on Transition Metal based Sodium Ion Batteries (SIBs) for Ultrafast Energy Storage Systems on 13th November 2019.*

*Energy storage is the need of the hour, as we switch gear to the next dimension of sustainable development. Energy storage is a ground breaking technology with the potential to set the economy to grow and our nation to glow. Now there is a rising demand for Energy storage due to the growing market for consumer electronics and demand for electric vehicles. Hence the researchers and academicians are duty bound to follow the trend and contribute their knowledge to make our nation a pioneer in this sector.*

*Battery energy storage systems are rechargeable battery systems that store energy from renewable sources like solar arrays and wind energy or the electric grid and provide that energy to a home or business. Because they contain advanced technology that regular batteries do not, they can easily perform certain tasks that used to be difficult or impossible, such as peak shaving and load shifting. During daylight, the battery storage system is charged by clean electricity generated by solar. Intelligent battery software uses algorithms to coordinate solar production, usage history, utility rate structures, and weather patterns to optimize when the stored energy is used. Deployment of this technology can change the face as well the fate of our planet.*

*Hence this conference will be an extensive forum to discuss technical advancements in Battery energy storage systems.*

*Dr. N.G.P. Institute of Technology takes pride in organizing the National conference to create unique platform to analyze the present and future objectives and to update technological advancement in Battery energy storage systems.*

**Dr. Thavamani D. Palniswami**

**Secretary**

# CEO's Message

*I am extremely happy to know that the Department of Science and Humanities, Dr. N.G.P. Institute of Technology, Coimbatore is organizing a DST-SERB sponsored National conference "Transition Metal based Sodium Ion Batteries (SIBs) for Ultrafast Energy Storage Systems" sponsored by SERB on 13th November 2019. The conference will provide unique learning opportunities for academicians, researchers and students working in this field.*

*The speakers of various keynote sessions will share the knowledge to the young minds of the participants. The conference will provide an important channel for exchange of information among researchers and student fraternity. The scientific community has a major role to play is shaping our future.*

*We hope that this conference provides a platform for the intellectuals working in this field. I extend my warm greetings to the participants and organizers and wish the conference a great success.*

O. T. Buvaneswaran

**Dr. O.T. Buvaneswaran**

**CEO, KMCRET**

# Principal's Message

*Warm and Happy greetings to all. It gives me great pleasure to welcome you to the DST-SERB sponsored National Conference on "Transition Metal based Sodium Ion Batteries (SIBs) for Ultrafast Energy Storage Systems". Conferences are providing opportunities for researchers and faculty members and students for networking and collaboration among the peer groups along with publications in a peer reviewed journals/ proceedings.*

*I am sure that this conference will provide an excellent platform for the engineers, researchers and academicians of various organizations and practicing engineers employed in R & D establishments to share their rich experience in the recent developments.*

*Under the able guidance of our Chairman and the Secretary Madam continues to march on the way of success with confidence. The sharp, clear sighted vision and precise decision making powers of our management has benefited our college to say competitive.*

*I have great pleasure in congratulating the organizers of the conference who have endeavored with enthusiasm in organizing this mega event in our College.*

*I wish the conference great success.*

***Dr. K. Porkumaran***

***Principal***

# HoD's Message

*In the ever growing energy demand scenario, aggravated by fast depleting fossil fuel resources, it is necessary to search for alternate energy resources for the smooth sailing of human life in all dimensions. India, being a tropical country, is rich of natural renewable resources for energy, with solar energy predominating. Hectic research is on maximizing the energy harvest from renewable resources, and in this perspective, storing the harvested energy also needs to be given equal importance. Currently, batteries are taking a leading role in storing the energy. However, there are great challenges to be addressed in energy storing mechanism and battery technology, as the batteries are bulky, lesser energy capacity, poor charging cycles etc. In this perspective, I am immensely pleased to note that Physics department has initiated constructive methods to address above mentioned issues and to offer solutions. I wish this conference a grand success and I am sure that all the delegates will enrich their knowledge and expose the newer dimensions of battery technology and encourage on pursuing research further at their parent institutions for the benefit of mankind.*

**Dr. C. Vivekanandan**

**Professor & Head,**

**Department of Science & Humanities**

# Foreword

*The National Level Conference on "Transition Metal based Sodium Ion Batteries (SIBs) for Ultrafast Energy Storage Systems" sponsored by Science and Engineering Research Board (SERB), Government of India, New Delhi-110070 is being held at Department of Science And Humanities, Dr. N.G.P. Institute of Technology, Coimbatore-641048 on 13th November -2019. This book contains the abstracts of invited talks and contributed research from India. Contribution of research papers are from diverse and specified fields of the conference. A total of 104 abstracts have been received in a short span of time. This National conference includes a keynote address which deals with "Rechargeable Sodium-ion Battery Development" by* ***Dr. Sagar Mitra,*** *Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Powai, Mumbai 4000 76, India. The topic "Design higher efficiency cathodes for Li-ion and non Li-ion batteries" dealt by* ***Dr. P.Ravindran****, Professor, Department of Physics, Central University of Tamil Nadu, Thiruvarur, India. "Towards Indigenous Lithium ion Battery and Beyond" would be delt by* ***Dr. S. Gopukumar****, Emeritus Scientist Electrochemical Power Systems Division Central Electrochemical Research Institute (CSIR) Karaikudi – 630 006, Tamil Nadu, India.*

*We take this opportunity to thank all the National Advisory Committee members, Steering Committee members for their valuable suggestions and support. We also thank Research Scholars and B.E. Engineering students of Dr. N.G.P. Institute of Technology for rendering help in various activities. This type of National Conference is being convened for the first time at the Department of Science and Humanities, Organizing such a wonderful event in this campus has been achieved because of the whole hearted support extended by Dr. Nalla G. Palaniswami, Chairman, KMCH and Dr. Thavamani D. Palaniswami, Secretary, Dr. N.G.P. Institute of Technology. I would like to record my heartful thanks to the CEO Dr. O.T. Buvaneswaran, KMCRET, the Principal Dr. K. Porkumaran, Professor & Head , Dr. C. Vivekanandan, Department of Science and Humanities, Faculty members, Administrative Staff and Non-Teaching Staff of Dr. N.G.P. Institute of Technology for their kind support, encouragement and help in all matters related to this National Conference. We would also like to place it on record, our sincere thanks and appreciation for our sponsoring agency SERB, Government of India, New Delhi for their kind co-operation and generous contribution in various forms in organizing the National Conference.*

**Dr. E. Ranjith Kumar**

**Organizing Secretary -NCTMSIB'19**

## LIST OF SPEAKERS

1. **Dr. Sagar Mitra**
   Department of Energy Science and Engineering,
   IIT Bombay,
   Powai, Mumbai - 400 0076,
   INDIA.
   Topic: **Rechargeable Sodium-ion Battery Development**

2. **Prof. P. Ravindran**
   Department of Materials Science,
   Central University of Tamilnadu,
   Neelakudi, Thiruvarur-610005,
   Topic: **Design higher efficiencycathodes for Li-ion and non Li-ion batteries**

3. **Prof. S. Gopukumar**
   Emeritus Scientist
   Central Electro-Chemical Research Institute
   (CSIR- CECRI), Karaikudi - 630 006, TamilNadu, INDIA.
   Topic**: Towards Indigenous Lithium ion Battery and Beyond**

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Dr. P. Selvakumar

# Programme Schedule

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| Welcome Address | **Prof. Dr. C. Vivekanandan**<br>HoD, Department of Science & Humanities<br>Dr. N.G.P. Institute of Technology | |
| Presidential Address | **Dr. Nalla G. Palaniswami**<br>Chairman, KMCH<br>**Dr. Thavamani D. Palaniswami**<br>Secretary, Dr. N.G.P. Institute of Technology | |
| Felicitations | **Dr. O.T. Buvaneswaran**<br>Chief Executive Officer, KMCRET<br>**Dr. K. Porkumaran**<br>Principal, Dr. N.G.P. Institute of Technology | |
| Overview of the Conference | **Dr. E. Ranjith Kumar**<br>Organizing Secretary- NCTMSIB'19 | |
| Keynote Address - I | **Dr. Sagar Mitra**<br>Department of Energy Science and Engineering,<br>IIT Bombay,<br>Powai, Mumbai - 400 0076,<br>INDIA.<br>Topic: **Rechargeable Sodium-ion Battery Development** | 10.15 am - 11.15 am |
| Keynote Address - II | **Prof. P. Ravindran**<br>Department of Materials Science,<br>Central University of Tamilnadu,<br>Neelakudi, Thiruvarur-610005,<br>Topic: **Design higher efficiencycathodes for Li-ion and non Li-ion batteries** | 2.30 pm -4.00 pm |

| **Article presentation 11.30 am to 1.30 pm** | | |
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| **Session I:** | **Session II:** | **Session III:** |
| **Session Chair**<br>Dr. R. Mariappan<br>Asst. Professor,<br>Adhiyamaan College of Engineering,<br>Hosur-635 109.<br>Tamil Nadu. | **Session Chair**<br>Dr. B.Nalini<br>Assistant Professor<br>Department of Physics<br>Avinashilingam Institute for Home Science and Higher Education for Women<br>Coimbatore-43 | **Session Chair**<br>Dr. S. Bhuvana<br>Assistant Professor<br>Dr.N.G.P. Institute of Technology,<br>Coimbatore-48 |

***Morning tea break:** 11.15 am -11.30 am
***Lunch:** 1.30 pm to 2.20 pm
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# Rechargeable Sodium-ion Battery Development

**Sagar Mitra**

*Department of Energy Science and Engineering*

*Indian Institute of Technology Bombay, Powai, Mumbai 4000 76, India*

## Abstract

Sodium-ion battery is a resourceful, environment-friendly and low-cost electrochemical energy storage device. A great deal of research has been devoted to various sodium-storage materials and sodium-ion batteries. The main obstacle to establishing this technology is the poor cycle stability which results from large stresses in the electrode material upon sodiation-desodiation resulting in the fast degradation of the material structure and electrolyte compatibility. Also, large-size Na-ions have few active sites in the material and diffuse slowly in the lattice, causing low specific capacity and poor rate capability. Extensive basic research regarding material design and preparation, battery construction and performance evaluation is compulsory to resolve the above problems. This lecture will be devoted to understand the drawbacks of sodium-ion storage technology and showcase a few new developments in our laboratory.

# Design higher efficiencycathodes for Li-ion and non Li-ion batteries

**P.Ravindran**

*SCANMAT CENTER, Department of Physics, Central University of Tamil Nadu, Thiruvarur, India*

**Abstract**

As the worlds is undergoing a shift in its perception about the renewable energy sources and its capability to dealwith the increasing energy demand and mitigate the environmental degradation, the renewable energy sector has flourished both financially and technologically. The advancements in this field can possibly improve the energy security and mitigate the climate change and related problems .Due to intermittent nature of the renewable energy sources, the energy storage is one of the important components in implementing renewable energy technologies. The energy storage technologies, lead mainly by the high energy density Li-ion battery, are coping up with the increasing rate of energy production despite the setbacks in terms of the depleting Li-resources and geopolitical constraints . This induced the idea of research in non-Li ion-based battery chemistries among scientists across the globe. Na and K-ion batteries deserve special mention owing to their evenly distributed in the earth crust and the sufficient availability of resources compared to Li to implement in large scale. Though, the Na and K-ion based battery technologies are far from commercialization due to the poor energy density and specific capacity compared with those of Li-ion batteries, they are attracting widespread attention. In this talk, the general concepts of battery technology and the history of development of Li-ion batteries will be discussed. Also, the emergence of Na ion batteries and different components of the batteries will be discussed in detail with special focus on cathode materials. Computational analysis of Li-rich material $Li5FeO_4$ will be presented along with the thermodynamic and electronic studies on the properties of polyanionic $Na_2MnSiO_4$. The design of cathode materials for non-Li battery is based on improving the material properties like achieving low cost, recharge ability, safety, obtaining high voltage and fast charge/discharge capability etc. In this talk, I will present different techniques that are used to analyses the properties of battery materials followed by the discussion on improving the capacity of battery by the extraction of more than one electron in one redox reaction, either with the help of transition metals or by using multivalent intercalating ions like Mg.

# Towards Indigenous Lithium ion Battery and Beyond

**S. Gopukumar**

Emeritus Scientist Electrochemical Power Systems Division Central Electrochemical Research Institute (CSIR), Karaikudi – 630 006, TamilNadu, India

**Abstract**

The lithium ion battery has evolved as the major power source ever since it's discovery in 1991 by Sony and represents one of the major successes of materials electrochemistry. Lithium ion batteries are becoming more and more popular in view of the multifarious applications ranging from consumer electronics to space and also for electric vehicles due to their high voltage and high power leading to light weight and smaller size cells/batteries. In view of the growing day to day demand for lithium ion batteries, intensive research is being pursued globally to develop new high performing cost effective electrode and electrolyte materials and importantly without compromising on environmental issues. Further, sodium ion batteries are also emerging as an alternative to lithium ion cells owing to its low cost and abundance. In my talk, I shall give you an overview of the recent developments on the indigenization of the lithium ion cells especially by focusing on high performing carbon based anode and cathode materials. Details regarding the synthesis and characterization of high voltage cathode materials based on layered and olivine materials shall be presented in addition to the fabrication of 18650 and pouch cells and packs for various applications ranging from Solar Lantern to Energy Storage Devices and could be extended for Electric Vehicles. These cells could also be solar charged. Further, recent work on the development of electrode materials for the futuristic sodium ion batteries shall also be presented.

# Suitability evaluation of SnSbO towards Na battery anode application

**B. Nalini**

*Department of Physics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43*

## Abstract

Lithium –ion batteries are the most practical and superior kind among different energy storage devices. Still, limitations such as high cost, thermal runaway, limitation on power density and inadequate Li source are the barriers for expedient energy storage. As an alternative, the sodium ion batteries(SIBs) are being developed due to their surplus availability, and cost reduction factors. Developing an efficient anode with high specific capacitance is the major thirst. Antimony Tin Oxide(ATO) acts as a good anode material for sodium ion batteries, since it shows good performance on sodiation and desodiation with a theoretical capacity of Na15 Sn(847mAhg-1) and Na3Sb(660mAhg-1). Crystalline structural analysis for pre and post cycling analyses are made. Formation of interface is analysed using morphological, chemical compositional studies and spectroscopic analysis in pre and post cycling samples. Potentiostatic electrochemical performance is evaluated in aqueous half cells with NaOH as electrolyte. The half-cell sustained over 100 cycles and the results are presented here.

# Structural, compositional and FTIR spectroscopic studies of heat treated $CoFe_2O_4$ nanoparticles: Role of synthesis procedure

**Chris P Varghese[1,2 *] ,E. Ranjith Kumar[1'*]**

.[1]*Department of Science and Humanities, Dr. N.G. P. Institute of Technology, Coimbatore 643 048, India*

**Corresponding authorsE-mail: ranjueswar@gmail.com*

**Abstract**

Cobalt ferrite nanoparticles have been successfully prepared by sol-gel method assisted with cow-urine. The stoichiometric of present ferrite system was confirmed from the EDX spectrum. XRD patters revealed the spinel phase of present ferrite system and amorphous look is more evident in the ferrite systems sintered at low temperatures. Lattice parameter (8.254 – 8.296 Å) and crystallite size (3.7 – 4.2 nm) seems to be increasing with the heat treatment. The grain boundary energy released during the sintering process promoted the crystalline growth. The agglomeration of nanoparticles into large clusters due to strong magnetic interactions is visualized from the nature of SEM. The observed vibrational frequencies corresponding to the tetrahedral and octahedral bands confirm the spinel phase of present ferrite system. The variation of vibrational frequencies is not supporting the increase of lattice parameter with the heat treatment. This may supports the possible cation redistribution in the spinel structure. The results are discussed in terms of thermodynamical considerations.

# Metal organic frameworks (MoFs) and their Energy Applications

**Manickam Muthukkumar and Ammasai Karthikeyan**

*Department of Chemistry, Selvamm Arts and Science College (Autonomous), Namakkal,Tamil Nadu, India*

*Corresponding Author: chemmk70@gmail.com*

## Abstract

MOFs are a class of materials that are defined, in their most basic sense, as being a crystalline material composed of connectors (metal atoms or metal clusters), that are propagate infinitely in one or more dimensions by one or more bridging organic linker ligands.[1] This definition is very vague, and encompasses a wide variety of materials. Metal organic frameworks (MOF's) and coordination polymers have several applications as important material for construction of solar energy conversion devices, light emitting diodes, dye sensitized photoelectrochemical cells, molecular probes, sensors and photo catalyst. The MOFs materials serve as novel functional materials which are technologically important and MOF's represent a new class of materials of Solid state solar energy materials.[2] The present study is aimed at increasing our understanding of the interplay of coordination and hydrogen bonding in determining supramolecular organization of Cobalt carboxylate MOFs.

# A Comparative Study of Lithium, Sodium and Potassium Ion Batteries

**R. Rajkumar, and C.S. Manju**

*Department of Electrical and Communication Engineering, Dr.N.G.P. Institute of Technology, Coimbatore 641048, Tamil Nadu, India.*

## Abstract

The Li-ion technology is currently the best performing technology for energy storage based on batteries. Li-ion batteries are used in small electronics (smart phones, laptops) and are the best options for electric cars. Li-ion batteries can catch fire, for instance because of a manufacturing problem. This is due in part to the presence of liquid organic electrolytes in current batteries. These organic electrolytes are necessary to the battery but highly flammable. Potassium-ion batteries (PIBs) have attracted tremendous attention due to their low cost, fast ionic conductivity in electrolyte, and high operating voltage. High–energy density electrodes need to be developed to guarantee high energy output, and structural stability should be maintained via material/electrode design to ensure long cycling performance. Sodium-ion batteries operating at ambient temperature hold great promise for use in grid energy storage owing to their significant cost advantages. However, challenges remain in the development of suitable electrode materials to enable long lifespan and high rate capability. In this paper, a comparative study of manufacturing technologies, advantages and disadvantages, Current and future research of Lithium, Sodium and potassium ions as storage elements have been discussed.

# Effect of Additive Adenine on Properties of Electrodeposited NiCoCr Thin Films

**S.P.Meena[1*] and R. Ashokkumar[2]**

*[1*] Research and Development Centre, Bharathiar University, Coimbatore-641 046, TamilNadu, India*

*[2]Assistant Professor, PG and Research Department of Physics, Thiruvalluvar Govt. Arts College, Rasipuram-637 401, Namakkal, TamilNadu, India.*

*meena.palanisamy@gmail.com*

**Abstract**

In this report magnetic thin films of NiCoCr were prepared with additive adenine by electrodeposition technique. The effects of additive on the composition, crystal structure, micro hardness, surface morphology, coercivity and magnetic saturation of the NiCoCr coatings were compared with the NiCoCr coatings without additive. NiCoCr deposited films are textured with FCC phase preferred orientation. From result, the films prepared with adenine exhibit high cobalt, chromium content and low nickel content. NiCoCr films were bright and uniformly coated on the surface. Crystallite size of the film was decreased when additive was added. The deposits of NiCoCr films were in nano scale. Hardness of the NiCoCr thin films was increased when adenine was added. From VSM result, NiCoCr thin films obtained with adenine have high saturation magnetization and high coercivity.

# Preparation and comparative study of Mg doped and Sn doped Sodium-ion batteries

**S.Manoj[1] and C. Selvakumar[1]**

[1] *Department of Physics, Dr.N.G.P. Arts and Science College, Coimbatore 641048,Tamil Nadu, India*

**Abstract**

The development of sodium-ion batteries (SIBs) has greatly impacted the advancement of portable electronic devices and electric vehicles. The low cost and huge availability of sodium compounds give SIBs a potential advantage in large-scale energy storage applications. A comparison study indicated that the Mg doped and Sn doped Sodium ion batteries. Sn doped sodium-ion batteries homogeneously embedded in spherical carbon network is prepared using an aerosol spray pyrolysis method. Mg doped sodiumion batteries homogeneously embedded in linear strecture is prepared using an co-priciation method. In Sn anodic scans, four well-defined peaks at 0.22, 0.30, 0.58 and 0.70 V are assigned to the desodiation of $Na_{15}Sn_4$, $Na_9Sn_4$, NaSn, and $NaSn_5$, respectively. sodium-ion storage performance, the Sn/NMC electrode shows an initial reversible capacity of 439 mAh $g^{-1}$ and maintains 332 mAh $g^{-1}$ after 300 cycles. An Mg doped sodium-ion batteries are high capacity retention of 93.8% (from 10th to 100th cycle) and 75.0% (from 10th to 200th cycle) as well as very high coulombic efficiencies, exceeding 99.6%, were obtained.125 mAh $g^1$ delivered capacity and 93.8% capacity retention (10the100th cycle).

# Cost-effective synthesis and characterization of solar mediated graphene oxide

**S.Subramani, N.Sivanandan***

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## Abstract

The preparation of reduced graphene oxide (rGO) via eco-friendly route is reported. The rGO is synthesized through sunlight as a solar mediated alternative to graphene oxide synthesized by other conventional me. The process is initiated with chemical oxidation of Graphite to graphene oxide by modified Hummer's method. X-ray diffraction results authenticate the formation of rGO. FESEM images shows sheet-like structure of GO and rGO. HRTEM images shows the presence of rGO collage with wrinkles more than that of GO. EDS analysis confirmed presence of elements C and O. The Raman spectrum shows increased number of $sp^2$ domain. In the FTIR spectrum, presence of characteristic absorption peaks of rGO (1567 and 2318 $cm^{-1}$) was observed. This cost effective method of forming rGO from GO along with specific properties leads to its applications in optoelectronic devices and photonics.

# Preparation and Micro structural Characterization of Electrodeposited Multilayers

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## Abstract

Magnetic multilayers were studied for their interesting magnetic properties compared to their monolayers. Past literatures, clearly suggests that non-magnetic elements plays vital role in the variation of magnetic properties in multilayers. These kinds of multilayers were traditionally prepared using expensive methods like sputtering, vacuum deposition and deposition techniques. In this work, influences of phosphorous in magnetic multilayers were reported by the comparative study of ternary and multinary multilayers on Copper substrate at optimized deposition parameters by electro deposition method. The prepared films were subjected to microstructural characterization which clearly suggests that the phosphorus strongly affect the tungsten presence in the layers. The deposition of multilayers and morphology were confirmed and studied using FE-SEM micrographs. The constituents in the films were studied using EDAX pattern.

# Review Paper on Electricity Generation using Rooftop Wind Ventilator

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## Abstract

Wind energy is one types of renewable energy and it does not cause pollution. Therefore, presently, there is the technological development of applying wind energy for the electricity generation. Wind energy is used to replace fossil energy such as oil and coal, causing environmental pollution. Since India is located in the tropical climate, the buildings, houses and industrial facilities prefer installing roof ventilators to vent hot air out of the roof. This paper presents the review on micro-generation of Electricity using Rooftop Turbine Ventilator. Various methods have been presented previously like Axial Flux Permanent Magnet (AFPM), Permanent Magnet Synchronous Generator (PMSG), DC Generator and AC Synchronous Generator which are driven by Rooftop Turbine Ventilator .Comparative study and modifications have been presented in this paper for above mentioned method with respect to roof top ventilator. Energy generated from this concept is stored in batteries for further use.

# Green synthesis of $MgFe_2O_4$ nanoparticles: Evaluation of structural, magnetic and biological activities

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## Abstract

Lemon juice assisted combustion method was adopted to prepare $MgFe_2O_4$ nanoparticles and the prepared samples were annealed at 600 ˚C and 900 ˚C. The effects of natural citric acid and annealing temperature on structural, magnetic and biological activates of $MgFe_2O_4$ nanoparticles have been analyzed. The phase and structural analysis of $MgFe_2O_4$ nanoparticles have been studied by X-Ray Diffraction (XRD) and Transmission Electron Microscope (TEM). The single phase spinel structure of $MgFe_2O_4$ nanoparticles has been identified by XRD spectra and the traces of secondary phase peaks have not been found. The average crystallite sizes are found to be in the range from 12.4 nm to 34.5 nm. TEM images showed the spherical shaped particles with the average size of 35 nm and are well matched with the crystallite sizes calculated from XRD profile. The magnetic measurement was recorded by using VSM and SQUID. The effects of particle size with the impact of annealing temperature on magnetic parameters are also analyzed. The green synthesized $MgFe_2O_4$ nanoparticles shows excellent biological activates.

# Enhanced opto-magnetic and photo-catalytic properties of rare earth element (REE) $Ce^{3+}$ doped $Co_{0.5}Zn_{0.5}Fe_2O_4$nanoparticles synthesized by sol-gel combustion method

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## Abstract

In this present study, pure and rare earth element (REE) $Ce^{3+}$ doped $Co_{0.5}Zn_{0.5}Fe_2O_4$ ($Co_{0.5}Zn_{0.5}Fe_{2-x}Ce_xO_4$ where x = 0.0, 0.025, 0.05, 0.075, and 0.1) nano-ferrites were successfully fabricated by modified sol-gel combustion method and qualitative studies such as structural, morphological, optical and magnetic properties were carried out using X-ray powder diffractometer (XRD), Fourier transform infrared spectroscopy (FTIR), high resolution scanning electron microscopy (HR-SEM) equipped with energy-dispersive spectroscopy (EDS), high resolution transmission electron microscopy (HR-TEM) equipped with selected area electron diffraction pattern (SAED), diffuse reflectance spectroscopy (DRS), room temperature photoluminescence (RT-PL) and vibrating sample magnetometer (VSM) techniques.XRD analysis was confirming the formation of a single-phase cubic spinel structure and the average crystallite sizes are less than 50 nm calculated using the Scherrer formula. FT-IR spectra revealed the band shifting of lower-frequency to higher side with doping of larger ionic radii of $Ce^{3+}$ ions. EDX analysis confirmed the expected elements only present in the final products and no other impurities were found. The influence of REE $Ce^{3+}$ ions on the optical and magnetic properties of the samples was studied using DRS and VSM analysis respectively and are found that the enhancement of optical and magnetic properties. These properties reveal superparamagnetic nature of $Ce^{3+}$ doped $Co_{0.5}Zn_{0.5}Fe_2O_4$nanoparticles. Photocatalytic degradation (PCD) of organic pollutant methylene blue (MB) dye was carried out using UV-Vis irradiation and the obtained results revealed the value of PCD efficiency increases with the addition of $Ce^{3+}$ ions and can be suitable for catalyst and humidity sensors. The PCD activity of $Ce^{3+}$ doped $Co_{0.5}Zn_{0.5}Fe_2O_4$ was found to be enhanced with increase in REE $Ce^{3+}$ ions as it cause a reduction in the grain size.

# Synthesis and characterization of $TiO_2$ thin film sensitized *Pterocarpus Soyauxii* natural dye for Energy storage systems

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**Abstract**

In the present work, $TiO_2$ thin films were deposited on glass substrate using SILAR process at room temperature by varying the number of SILAR cycle. It is a unique method in which thin films of compound semiconductor can be deposited by alternate dipping of a substrate into the aqueous solutions containing ions of each component. The formation of film thickness at monolayer is controlled by the SILAR method. The XRD study indicates that the film deposited at higher growth rate is polycrystalline in nature exhibiting the anatase phase. The transmittance, absorption co-efficient and absorption index of the $TiO_2$ films wereanalyzed.It is found that the band gap of as-deposited $TiO_2$ film was decreased during annealing and dye sensitization.SEM image reveals that the particles making of the films form a cluster of $TiO_2$ due to agglomeration. The film also has a porous structure. The EDX spectrum confirms the titanium and oxygen atoms present in the prepared $TiO_2$ films. From the results, we confirm that *Pterocarpus Soyauxii*sensitized $TiO_2$ material is a potential candidate for energy storage application.

# On the role of $NH_3$ and NaOH co-reagents during PEG-assisted synthesis of CdO nanostructures by microwave irradiation method

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## Abstract

Cadmium oxide nanostructures have been successfully synthesized by microwave irradiation method, in the presence of polyethylene glycol (PEG), using $NH_3$ and NaOH as co-reagents. A systematic investigation by X-ray powder diffraction (XRD), scanning and transmission electron microscopy (SEM and TEM) andenergy dispersive spectroscopy (EDS) has been undertaken to evaluate the effect of co-reagents on the microstructural and morphological properties of the metal oxide nanostructure obtained. The pH of the solution, determined by the co-reagent used, was the main parameter addressing the morphology of CdO nanostructures obtained. By using $NH_3$, the growth of individual CdO nanowires is favored at the low pH of 9, likely due to low Cd supersaturation rate at this pH. On the other hand, the presence of NaOH as co-reagent increases pH to 11, enhancing Cd supersaturation and leading mainly to formation of nanowire aggregates. The optical and photoluminescence characteristics of the different CdO nanostructures synthesized have been also evaluated.

# Pulverization of CuS: $Sn_2Sb_3$: a potential anode for Sodium-ion battery

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**Abstract**

The Lithium ion batteries have majorly dominated the field of electrochemical energy storage devices. Still, difficulties such as high cost, thermal runaway, limitation on power density and inadequate Li source are the barriers.In this aspect, the sodium ion batteries could play a good role in cost-reduction and find its application in large scale grid energy storage.Hence, finding an anode material with high theoretical capacity, electrochemical stability and good alloying/ dealloying reaction with sodium ions are the major quest. Tin antimony ($Sn_2Sb_3$) as an anode exhibits remarkable theoretical capacity of 753mAhg$^{-1}$and pulverization of sulfide based material along-with that would be a better option for obtaining high capacitance anode for sodium ion batteries. Copper sulfide (CuS) and $Sn_2Sb_3$(CuS: $Sn_2Sb_3$)exhibits a high theoretical capacitance value of 1313 mAhg$^{-1}$. Hence, these two compounds are prepared separately by co-precipitation method and is pulverized in equal ratio. Further, their structural andelectrochemical performance are studied. It is interesting to note that just pulverization results in good performance unlike any other combination. Through XRD, it is understood that these two compounds form composite without any secondary phase formation. The phase composition of CuS: $Sn_2Sb_3$ is confirmed by Raman analysis. The electrochemical performance is studied using Cyclic voltammogram and galvanostatic charge-discharge studies. From the GCD curves, a cyclic stabilityfor 200 cycles is obtained.

# Investigation of structural, morphological and magnetic properties of green synthesized Mg substituted $CuFe_2O_4$ nanoparticles for humidity sensor applications

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## Abstract

The effects of lemon juice and annealing treatment on structural, morphological and magnetic behavior of Mg substituted copper ferrite nanoparticles have been analyzed. The various techniques are used to examine the structural, micro structural and magnetic nature of the samples at different annealing temperatures (600˚C and 900˚C). The phase and microstructure of Mg substituted $CuFe_2O_4$ nanoparticles have been analyzed by X-Ray Diffraction (XRD) and Transmission Electron Microscope (TEM). The secondary phase peaks free XRD spectra confirmed that the as burst and the annealed Mg-$CuFe_2O_4$ nanoparticles have single phase cubic spinel structure. The average crystallite sizes are in the range from 8.9 nm to 39.5 nm. The spherical shaped particles with the average size of 35 nm have been recorded by TEM and the estimated particle sizes are well matched with XRD. The magnetic properties are recorded by using Vibrating Sample Magnetometer (VSM). The size-dependent Mg-CuFe2O4 nanostructures exhibit promising sensing capabilities which ensure them as a potential candidate for humidity sensors.

# Hydrogen gas sensing characteristics of $SnO_2$: CuO nanocomposite

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**Abstract:**

In the present study investigates the intensive studies of $SnO_2$: CuO nanocomposite synthesized by impregnation protocol process for hydrogen gas sensor. The detailed analysis of synthesized material was carried out by X-ray diffraction, transmission electron microscope and particle size analyzer. Present nanocomposite follows n-p semiconducting nature, which exhibits an efficient conductivity and superior stability through nano structural materials. The significantly improved performance was thoroughly explained interms of adsorption – desorption mechanism.

# Effect of $Cd^{2+}$ substituting on the structural and optical properties of $CeO_2$ nanoparticles

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## Abstract

$CeO_2$ and $Ce_{1-x}Cd_xO_2$ nanoparticles were synthesized using chemical precipitation method. Powder X-Ray Diffraction (PXRD) patterns of all the nanoparticles confirm the cubic structure of $CeO_2$ and the size of nanostructured $CeO_2$ are found to be in the range of 3.6 nm to2.7 nm with $Cd^{2+}$ concentration. The SEM image showed that $CeO_2$ nanoparticles are spherical shape with minimal aggregation. Fourier transform infrared(FTIR) analysis confirms the formation of $Ce_{1-x}Cd_xO_2$ with that of $CeO_2$.UV-VIS optical absorption spectra shows the blue shift in the absorption edge with increasing of $Cd^{2+}$ concentration. The PL emission peak shows the two emission bands which are assigned to near band edge emission and blue emission.

# Study of Structural and D.C. Electrical properties of Co-precipitated Mn-Ni Nanoferrites in the context of $Mn^{2+}$

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## Abstract

Mn-Ni nanoferrite system ($Mn_xNi_{1-x}Fe_2O_4$) was synthesized by co-precipitation method and after followed by heat treatment at 500$^o$C. In order to search for microwave radar frequency applications, the ferrite samples are analyzed their structural and electrical properties as a function of substitution of $Mn^{2+}$. The substitution of $Mn^{2+}$ promotes the increase in crystallite size and lattice parameter. It was observed that the D.C electrical resistivity of the sintered samples decreases over a temperature range of 303 K – 423 K (30$^o$C - 150 $^o$C) indicating semiconducting behavior of samples. The Curie temperatures ($T_C$), which indicates transition of magnetic order from ferromagnetic to paramagnetic order. The activation energy (ΔE) for the thermally activated hopping process, which specifies the energy required for the charge carriers for hopping process, was also observed to be decreasing.

# A brief review on Sodium Ion Batteries (SIBs)

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**Abstract**

Energy production and storage technologies have attached a great deal of attention for day to application. In recent decades, advanced in lithium -ion batteries (LIB) have improved living condition around the globe.LIB are mostly used in mobile electronic devices as well as in zero emission electronic vehicles. However, there are increasing concerns regarding load leveling of energy sources and the smart grid as well as the sustainability of lithium sources due to their limited availability and consequent expected price increases .Therefore, whether LIB 's alone can satisfy the rising demand for small - or mid- to -large format energy storage application remain unclear . To mitigate these issues, recent research has focused on alternative energy storage systems. SODIUM ION BATTERIES SIB's are considered as the best candidate power source because sodium is widely available and exhibit similar chemistry to that of LIB's; therefore, SIB's are promising next generation alternative. Recently sodiated layer, transition metals oxides phosphate and organic compounds have been introduced as cathode material for SIB's. Simultaneously, recent developments have been facilitated by the use of select carbonaceous material, transition oxides or sulfides and inter metallic and organic compounds as anodes for SIB's. Apart from electrode material, suitable electrolytes, additives and binders are equally important for the development of SIB's. Despite development in electrode material and other components, there remain several challenges including cell design and electrode balancing in the application of sodium ion cells. In this article we summarize and discuss current research on materials and propose future directions for SIB's. This will provide important insight into scientific and practical issues in the development of "SIB'S".

# Nanostructural, Surface Morphology and Optical Properties Of $CuMnSe_2$ Nanoparticles Synthesized Via Chemical Precipitation Method

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**Abstract**

Copper selenide films have a wide direct band gap in the range between 2.1-2.7 eV. Nowadays, the preparation of metal selenide thin filmshas been explored by number of deposition techniques for various potential application such as supercapacitor, solar cell etc. Hence, it is motivated to work on nanostructured $CuMnSe_2$, synthesized by Chemical precipitation method. The synthesized $CuMnSe_2$ nanoparticles (NPs) characterized by Powder X-Ray Diffractometer (PXRD)reveals the formation of tetragonal phase of $CuMnSe_2$ and it correspondsto Chalcopyrite family of space group I-42d. The average grain size of the synthesized $CuMnSe_2$ nanoparticles were calculated from Scherrer's formula about 33nm. Scanning electron microscope revealed the agglomerated nanoparticles with porous surface. The optical property of the $CuMnSe_2$ nanoparticle was analyzed by UV–Visible spectroscopy. The absorbance spectrum was obtained in the range of 300-1100 nm. The energy band gapof $CuMnSe_2$ nanoparticles was found to be 2.17 eV from Tauc's plot. Since, the conductivity of above material is enhanced well, it can be further used effectively for solar cell fabrication.

# Power quality analysis in a commercial establishment

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## Abstract

In today's fast changing world, reducing the impacts of poor power quality on modern buildings which have proliferation of non-linear load in the electrical distribution systems has become very important. These buildings have caused generation of harmonic currents and consequently harmonic voltages. An increasing demand for high quality, reliable electrical power, and increasing number of distorting loads may demands an increased awareness of power quality both by customers and suppliers. The various problems in power quality have a major concern among researchers and electrical engineers. It would be useful and necessary to monitor and study the power quality disturbances to mitigate these problems for improving the power quality in a building. This power Quality monitoring and analysis brings about the verification, monitoring and analysis of use of electrical energy, including submission of technical reports containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce the energy consumption of an organization of a commercial building. This paper a case-study analysis presents the steady state monitoring performed on one part of the 109KW distribution system of a commercial building. The study, a part of a research project includes measured waveform, trends and analysis of the measurement data taken. The results are analyzed and comparison is made in order to evaluate the quality of power in a typical commercial building.

# Sodium-Ion Battries: Presen and Future

**R. Aiswarya and Gowthaman**

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**Abstract**

Energy production and storage technologies have attracted a great deal of attraction for day to day applications. In recent decader, advances in lithium-ion battery (WIB) technology have improved living conditions around the globe. WIB's are used in most mobile electronic devices. However, there are increasing concerns regarding load leveling of renewable energy sources and the smart grid as well as the sustainability of lithium sources due to their limited availability and consequent expected price increases. Sodium-ion batteries (SIBS) are considered as the best candidate power sources because sodium is widely available and exibits similar chemistry to that of WIBS; therefore, SIB's are promising next generation alternatives. Recently, sodiated layer homisition metal oxides, phosphates and organic compounds have been introduced as cathode materials, for SIB's. Simultaneously, recent developments have been facilitated by the use of select carbonaceous materials, transition metal oxides (or sulfides), and intermetallic and organic compounds as modes for SIB's. A part from electrode materials, suitable electrolytes, additives, and binders are equally important for the development of practical SIB's including cell design and electrode balancing, in the application of sodium-ion cell. odium-ion batteries (WIB's) show great promise for melting the material supply and cost demands of large scale energy storage system (LSS's) used for the application of renewable energy sources and smart grids. Representative electrode materials are highlighted to illustrate advances in corresponding features. The insights presented in this review can inspire further research interest into NIB design and serve as a guide for the application of NIB's in large-scale stationary energy storage.

# Comparing Metal ion compensators enhance the luminescence efficiency in $ZrO_2$:(0.01$Dy^{3+}$) nanophosphors

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## Abstract

$ZrO_2$: (1 mol %) $Dy^{3+}$:$xA^+$(A = Li, Na and K) phosphors were prepared by one step, low temperature solution combustion method. Structures of $ZrO_2$: (0.01) $Dy^{3+}$: $xA^+$ (x = 0.01, 0.03, 0.05, 0.07 and 0.09) samples, obtained from X-ray diffraction reveal formation of different phases. Influence of alkali metal ions on surface morphology were realized from the SEM micrograph. The functional groups present in the prepared samples were analyzed by FT-IR spectroscopy. PL spectra of all samples excited at 350nm exhibited two strong emission peaks centered at 480nm and 580nm, which were due to the $^4F_{9/2}\rightarrow{}^6H_{15/2}$ and $^4F_{9/2}\rightarrow{}^6H_{13/2}$ transitions of $Dy^{3+}$ ions respectively. However the relative intensity between these peaks varies considerably due to the variation of the co-dopant (Li, Na, K). Effects of different charge compensator ($A^+$) and their concentration on the structural and luminescence properties of $ZrO_2$:(0.01)$Dy^{3+}$:$xA^+$ phosphors were thoroughly investigated. Luminescence intensity, emission colour and phase of $ZrO_2$:(0.01)$Dy^{3+}$ phosphors were improved remarkably with the addition of charge compensators ($A^+$), which would promote their applications in white light-emitting diodes with near- ultraviolet chip.

# Highly selective detection of mercuric ion using Ag NPs in the presence of amino acid

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## Abstract

In recent decades, environmental sensors to detect toxic heavy metal pollution due to rapid industrialization as reached great interest. The development of rapid, cost-effective colorimetric sensors for detection of pollutants in air, water and soil samples are in great demand. The present study reports an analytical tool for Hg2+ ion detection using synthesized Ag NPs probe in the presence of specific amino acid. The Ag NPs was synthesized using chemical reduction method in presence of stabilizing agent. The particle were characterized by UV-visible spectrophotometer, scanning electron microscope, X-ray spectrometer, particle size analyzer and zeta sizer. The zeta potential of the particle is around -40 mV and particle size is 6 nm. The Ag NPs – amino acid conjugate able to detect Hg2+ ion in low nano molar level. The probe solution changed from brownish yellow to colourless with increase in mercuric ion concentration. A good linear relationship is found between absorbance and Hg2+ ion concentration (200-1000 nM) under optimized condition. The sensing was not influenced by changes in environmental parameters including pH, temperature and salt concentrations. The interference of other metal ions does not affect Hg2+ ion detection and can be used for effective practical application. The paper and gel based sensors were developed for user friendly assay methods. Furthermore, the change in pH of solution to 11 after detection helps in separation of mercuric ion by causing precipitation. This method can be used for qualitative and quantitative assay for mercuric ion detection.

# Highly sensitive colorimetric detection of Hg(II) using bimetallic Ag-Cu NPs in the presence of amino acid

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## Abstract

Toxic metal pollutants, specially mercury that causes deleterious effects to the environment and human health even at low concentrations. Therefore, it is very important to establish a highly selective and sensitive method for the detection of Hg(II) ions in real time samples. Here, we report an extensive study of colorimetric detection of Hg(II) using bimetallic silver doped copper nanoparticles (Ag-Cu NPs) in presence of Amino acid. The chemical reduction method was employed in synthesizing the Ag-Cu NPs. This particle was characterized by UV–visible spectrophotometer, scanning electron microscopy, Energy-dispersive X-ray spectroscopy (EDS), particle size analyzer and zeta analyzer. The synthesized Ag-Cu NPs were reddish Yellow in color where colour change was observed with increase in Hg(II) concentration to colorless. The conjugated of Ag-Cu-Aminoacid was able to detect Hg(II) at low nano molar concentration. The particle size measurement is 8 nM and zeta potential of the particle is -38 mV. Under optimized condition, an excellent linear relationship is found between absorbance and Hg(II) ion concentration (20-100 nM). The present study can be applied for the development of a paper strip-based and gel based sensor for the detection of Hg(II) from aqueous samples. The changes in pH, temperature, NaCl concentration does not affect the detection of Hg(II). The interference of other metal ions does not influence the Hg(II) detection. The study shows a sensitive and rapid detection method for the detection of Hg(II) from various aqueous samples. The methods suit for the analysis of environmental samples and it did not require any advanced instrumentations.

# Effect of Al doping concentration on the structural, optical, morphological and electrical properties of $V_2O_5$ nanostructures

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## Abstract

Study on the optoelectronic characteristics of a cation-substituted nanostructure is a specific area of recent interest for a wide range of photonic applications. In the present work, $Al_xV_2O_5$ (where x = 0, 5, 10 and 15%) nanoparticles were synthesized by a wet chemical-calcination process. X-ray diffraction study revealed the orthorhombic phase of 600ºC heat-treated pure and $Al^{3+}$ substituted samples. The shifting of the XRD lines with the substitution of $V_2O_5$ suggests that $Al^{3+}$ was successfully introduced into the $V_2O_5$ host lattice. The SEM and TEM images show that the pure and $Al^{3+}$ doped $V_2O_5$ hierarchical architectures are formed of one-dimensional nanorods. Photoluminescence spectra demonstrated the increment in deformities revealed by the immensely enhanced green emission. DC conductivity studies were performed in the temperature range 30–130ºC and it was found that the activation energy (Ea) is higher for $Al_xV_2O_5$ than for the undoped sample. The inherent current (I)–voltage (V) characteristics of pure $V_2O_5$ and $Al_xV_2O_5$ junction diodes showed a nonlinear diode-like behavior. The transient photocurrent under illumination is higher than the dark current, indicating that the fabricated diodes behave as a photodiode.

# Structural, morphological, optical and gas sensing properties of pure $SnO_2$ thin films prepared by jet nebulizer spray pyrolysis (JNSP) technique

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## Abstract

Tin oxide thin films are deposited on glass substrates with varying temperature between 300°C and 500°C in steps of 50°C. The films are characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive analysis of X-ray (EDAX), ultra violet-visible (UV-Vis) spectroscopy. The film thickness is calculated through surface analysis with stylus profile meter. The thickness of the films deposited at 300°C, 350°C, 400°C, 450°C and 500°C is found to be526 nm, 507 nm, 482 nm, 463 nm and 437 nm respectively. The investigation of XRD spectra reveals the tetragonal structure and polycrystalline nature of the films. The morphological study reveals the formation of spheres, interconnected fibers and O-ring shaped domains in the films fabricated at different temperatures. The elemental analysis indicates presence of tin (Sn), oxygen (O) and silicon (Si) in the prepared films. The band-gap energy ($E_g$) values of the films are calculated from the optical studies. Significant improvements are observed in gas sensing response, response time, selectivity and sensitivity in the films prepared through jet nebulizer spray pyrolysis (JNSP) technique.

# Improving biogas production from microalgae grown in wastewater with various feed stock

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**Abstract:**

The present work has evaluated of the inoculums in the anaerobic digestion process of various feed stock. The green micro algae *chlorella vulgaris* were isolated and cultured in photobioreactor used in these studies for biogas production with various feed stock combination. The experiments were carried out in mesophilic condition in laboratory. The differences in the quantities of biogas were produced from different feed stock are algae, cow dung, kitchen waste, cow dung-algae, kitchen waste-algae, kitchen waste-cow dung-algae. The comparing the amount of biogas evolved $7^{th}$ and $15^{th}$ day indicates that composite samples with algae yield more biogas after long period rather than in initial days. The quality of biogas depends on extent of methane present in gas evolved from carbon substrates. It is found that the GC analysis data indicates that composite mix of cow dung-kicthen waste-algae yields more $CH_4$ from other substrates.The study results indicate that cow dung-kitchen waste-algae combined feedstock produced more biogas and long period compare to other feedstock. The cow dung-kitchen waste-algae were selected for large scale biogas production.

# Catalytic Free Multicomponent reaction towards Dihydropyridine Derivative via Hantzsch Reaction

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## Abstract

Pyridine derivatives are one of the prevalent scaffolds in pharmaceuticals, natural products, and organic materials. Here we are intended to develop a simple and convenient methodology to construct Dihydropyridine. In multicomponent approach *via* Hantzsch reaction will have been to achieve by the condensation of an aromatic aldehyde, ketone flanked esters and ammonium acetate at room temperature in an aqueous medium. The novel and clean methodology offer advantages including short reaction time, good yields, operational simplicity and environmentally benign. The versatility of the reaction has to be check by employing various aldehydes (acyclic, cyclic and aromatic).

# Microwave assisted synthesis, biological evaluation and molecular docking studies of novel pyrido[2,3-a]carbazole derivatives

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**Abstract**

A new series of 2,3-thiophene-5,6-dihydro-11H-pyrido[2,3-a]carbazole-4-one derivatives, are synthesized from microwave irradiation reaction which has not been reported yet. The binding of this set of compounds with calf thymus DNA (CT-DNA) are investigated by electronic absorption spectroscopy, which indicates that pyrido [2,3-a]carbazoles can strongly bind to CT-DNA *via* intercalation mechanism. Gel electrophoresis assay demonstrates the ability of synthesized compounds to cleave the pBR322 *via* oxidative pathway. Further, investigation about the antioxidant properties showed that all synthesized compounds have a significant radical scavenging potency against DPPH and OH radicals. The cytotoxicity activities of all the synthesized carbazole derivatives are evaluated against three different cancer cell lines (HeLa, MCF-7 and HEp-2), which showed that the compounds exhibited substantial cytotoxic specificity on HeLa cell line over the other cancer cell lines. In order to understand the nature of the interaction of these molecules, we carried out molecular docking studies using the Check Point Kinase 1 protein inhibitors. The docking results provide some useful insights about the future design of more potent inhibitors.

# Remote Monitoring System For Renewable Energy Using Iot & Node Mcu(Esp-8266)

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## Abstract

Nowadays the solar panel performance is being affected by many factors such that environmental factors like dust, dirt & solar irradiation which will affect the efficiency of the panel. Solar energy is the important source of renewable energy and in future it will replace other energy in generation of power. Energy generation from solar panels should be noted in accurate value and to be maintained regularly otherwise it results in decrease of power loss. Therefore, the energy output through PV panels will not affect output as well as efficiency. In this paper, we are going to interface IoT with cloud storage which helps to store the live record of values produced in solar panel. In addition to this, we are developing a mobile app to check and monitor the readings (values).Using the readings we can monitor and control the power and also in generation of power so that we can reduce the loss.

# Electrode Materials for High-Performance Sodium-Ion Batteries

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## Abstract

Sodium ion batteries (sibs) are being billed as an economical and environmental alternative to lithium ion batteries (libs), especially for medium and large-scale stationery and grid storage. However, sibs suffer from lower capacities, energy density and cycle life performance. Therefore, in order to be more efficient and feasible, novel high-performance electrodes for sibs need to be developed and researched. This review aims to provide an exhaustive discussion about the state-of-the-art in novel high-performance anodes and cathodes being currently analyzed, and the variety of advantages they demonstrate in various critically important parameters, such as electronic conductivity, structural stability, cycle life, and reversibility.

# Synthesis and Characterization of Transition metal doped Ceria-Zirconia-Alumina mixed oxides

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**Abstract**

Ceria-Zirconia-Alumina mixed oxides was used as three-way catalysts in automobile exhaust control through its non-stoichiometric nature. The samples were prepared at pH-10 via co-precipitation approach. The insertion of dopant enhances the physicochemical properties of the prepared samples. The dopants also induce formation of oxygen vacancies which determines the reducibility of the mixed oxides which is essential for the catalytic conversion. The samples were characterized using X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and High Resolution Transmission Electron Microscope (HRTEM). The structural parameters were studied through XRD and it well accords with SAED pattern obtained from the HRTEM analysis. The presences of functional groups were identified using FTIR probe.

# Synthesis and applications of metal-organic framework composites

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## Abstract

The metal-organic frame works (MOFs) with the desirable photo-physical behavior is of very interesting due to their versatile applications. The combination of the high surface areas and micro porosity of metal-organic MOFs allows the preparation of tunable compositions with the tunable properties. The enhanced properties of these MOF are useful for applications in photo catalysis, energy, gas-storage and sensing. In this work, we discuss current strategies useful for battery applications.

# Preparation of organic acids treated $MoO_3$ thin films via spin coating method

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**Abstract:**

Molybdenum trioxide ($MoO_3$) thin films were prepared at room temperature (RT) and at different annealing temperatures of 250, 350, 450 and 550°C. We also prepared $MoO_3$ films using additives of water-soluble and water-insoluble organic acids. The thin films were coated using the spin coating technique and annealed at 350°C temperature. The effects of different annealing temperatures and different organic acid additives on $MoO_3$ films were characterized by structural and optical studies. From the XRD pattern, the structure of the $MoO_3$ films is found to vary with respect to increase in the annealing temperature. For RT and 250°C, the hexagonal structure was observed and for 350, 450 and 550°C, the orthorhombic structure was observed. The XRD pattern for all the organic acid additive used $MoO_3$ films exposed the orthorhombic structure. SEM images show hasty variations in the surface morphology for different annealed $MoO_3$ films and different additive used $MoO_3$ films. The EDX analysis confirmed the presence of Mo and O elements for all the films. The UV-Vis results show the absorbance and transmittance values. The band gap energy was found to be around 3.8 eV for all the $MoO_3$ films.

# Structural and morphological properties of $MoO_3$ & Zn doped $MoO_3$ nanoparticles based on the Simple wet chemical method

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## Abstract

The $MoO_3$ and transition metal of (Zn) doped $MoO_3$ nanostructures were synthesized by simple wet chemical method. In this article we used for the high well-organized $Zn_x$ (x = 0, 5%) nanoparticles. The process is simple, cost-effective and can be easily scaled-up. It was shown that the catalytic behavior of $MoO_3$ that is synthesized with this method. The $MoO_3$ and Zn/ $MoO_3$ nanoparticles were characterized by X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM) and scanning energy dispersive X-ray spectroscopy (EDS). Fourier transforms infrared (FTIR) and Raman spectroscopy. The obtained XRD and FESEM results confirmed the well dispersion of Zn nanoparticles and highly well improvement of the regular Zn nanoparticles on the surface of $MoO_3$ nanostructures. The chemical nature of the bonding confirmation details about the Zn doped $MoO_3$ is analyzed through vibration spectra of FTIR. The result showed that very well recognized material properties of the $MoO_3$ and Zn doped $MoO_3$ nanoparticles as superior performance of the characterization by using XRD, FESEM, EDS and FTIR analysis.

# Preparation and Characterization of Cobalt Doped Zinc Oxide Nano Structured Thin Films for Optoelectronic Applications

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## Abstract

Cobalt doped Zinc Oxide thin films are prepared on a glass substrate for various concentrations by sol-gel dip coating technique. The films are evaluated using Energy Dispersive spectroscopy (EDS), Scanning Electron Microscope (SEM), X-ray diffractometer (XRD), Ultraviolet Spectroscopy (UV), Fourier Transform Infrared (FT-IR) spectroscope and Thermo Gravimetric Analysis (TGA). The EDS result shows that the materials such as Zn and Co are present in the prepared thin films. The SEM result reveals that as concentration of the dopant increases the intermolecular space decreases and conductivity increases. The magnetic measurements confirmed the presence of ferromagnetism. The ferromagnetic order of the Cobalt nano particles are raising with increase in the thermal decomposition. The XRD pattern shows a dominating peak (002) indicating a c axis oriented wurtzite type crystalline structure. The UV spectrum shows that the minimum range of absorbance occurs at the visible region. The FT-IR spectrum shows the characteristics peak of ZnO at 490cm$^{-1}$. Even the Co is doped transmittance % is acceptable, which confirms that the doping of Co into ZnO lattice preserves its purity. All these properties show that the prepared films can used as TCO's in solar cells, LED and other optoelectronic applications.

# Characterization and Antibacterial Applications of Aluminium Doped ZnO Thin Films Prepared by SILAR Technique

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**Abstract**

Zinc Oxide (ZnO) and Aluminium (Al) doped ZnO thin films were prepared by two step SILAR technique. The structural, morphology, optical properties and antibacterial activity were analyzed for different doping ratio of Aluminium (1%, 3%, 5%) annealed at 250°C. Prepared films shows entire diffraction peak indexed to hexagonal wurtzite type structure. The lattice parameters and grain size were calculated for ZnO and Al doped ZnO thin films. The ZnO and Al doped ZnO thin films were confirmed using Field Emission Scanning Electron Microscope (FESEM). UV-Vis transmittance and absorption spectra for ZnO and Al doped ZnO thin films annealed at 250°C were also studied. The band gap changes as the doping ratio of Al increases from 1% to 5%. The maximum zone of inhibition was studied against the bacteria's E.coli (Gram-negative) and S.aureus (Gram-positive) using Agar diffusion method. The Al doped ZnO thin film shows significant antibacterial results when compared to ZnO thin films.

# Green synthesis of zinc oxide nanoparticles and investigation of its multifunctional properties

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## Abstract

Current study reports a simple and sonication assisted green process of zinc oxide nanoparticles (ZnONPs) using an aqueous extract of *Moringa oleifera*and evaluation of its antibacterial activity, anticorrosive and photocatalytic activity under sun light. The ZnO NPs were comprehensively characterized using ultraviolet–visible spectroscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, X-ray diffraction technique and Field emission scanning electron microscopy. Dynamic light scattering (DLS) and zeta potential of synthesized nanoparticles were analysed to know the size and stability of ZnONPs. Synthesized nanoparticles were stable, discreet, and mostly spherical with small agglomerations and size of particles was within the 05 - 20nm range.The anti–corrosive behaviour of ZnO NPswas investigated in NaCl electrolyte (sea atmosphere) using linear sweep voltammetry (LSV)The antibacterial activityof ZnO NPswere explored against *S.aureus and E. coli*by disc diffusion method. The photocatalytic activity was evaluated by measuring the decolourisation of methylene blue dye under sun light. This study concludes that the prepared ZnO NPs exhibits the better improvement in antibacterial activity, anticorrosive and photocatalytic activity compared with earlier reports.

# Selective Colorimetric Detection and Quantification of Arginine Using Silver Nanoparticle in Presence of $Pb^{2+}$

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**Abstract**

Arginine one of the essential amino acid in the human body for the ammonium regulation, although it is essential it also have more side effects which causes cardiac failure. The present probe investigated the detection of arginine using Ag nanoparticle. The Ag Nanosensor is chemically synthesized and the appearance of yellowish colour indicates the formation of Ag Nanoparticle. Due to surface plasma resonance (SPR) of the Nanoparticle the particle show different properties for different size of the nano particle and thus the reactivity of the nano particle is more than the other particles. The characterization of Ag Nanoparticle is done by UV-VIS spectroscopy Scanning electron microscope (SEM), Electron dispersive X-ray spectroscopy, Zeta sizer and particle sizer. The UV-visible absorption spectra showed a typical peak was obtained in 392 and 576nm of Ag nano particle. The particle size and zeta potential of the prepared Ag NPs was found to be 7 ± 1.2 nm and -32.96 ± 3 mV respectively. The study is a colorimetric and quantification of arginine in any aqueous media. The limit of detection of the present method was found to be 0.1 nM. The effect different environmental condition (Temperature, pH, interference and salinity) on the detection of arginine was studied. The paper strip method was made for the detection of arginine by naked eye. The UV-VIS spectroscopy and the paper strip method study deduct the arginine and this study will also used for the quantitative and qualitative analysis. This method has a remarkable feature about the high sensitivity of the arginine in very low concentration. The study can be used for the detection of arginine in the blood plasma of the human body.

# Synthesis and characterization of cerium doped zirconium oxide nanoparticles synthesized by microwave irradiation method

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## Abstract

Pure $ZrO_2$ and Ce doped $ZrO_2$ nanostructures have been synthesized by the microwave irradiation method. The prepared nanoparticles were characterized by various analytical techniques like Thermogravimetric and Differential Thermal Analysis (TG-DTA), X-Ray Diffraction (XRD), Fourier Transform Infra-Red Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Energy Dispersive Spectrum (EDS) and Transmission Electron Microscopy (TEM). The XRD pattern of Ce doped $ZrO_2$ nanoparticles have been confirms that the tetragonal structure. TEM observations indicated that the average particle size of the pure $ZrO_2$ some particles spherical shaped and some particles agglomeration in the range of 16-44 nm. Whereas on addition of Ce agglomeration in the range of 32-56 nm. The pure $ZrO_2$ and Ce doped $ZrO_2$ nanoparticles were further characterized for their optical properties by UV-Vis reflectance spectra (DRS) and Photoluminescence (PL) spectroscopy.

# Study of structural and magnetic properties of Mn-Mg nano ferrites in the context of energy storage applications in batteries

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## Abstract

A series of $Mn_xMg_{1-x}Fe_2O_4$) was synthesized by sol-gel combustion method. The samples are characterized for their structural and magnetic properties. The XRD patterns confirm the cubic spinel structure of ferrite phase. It was observed that the lattice parameter is randomly varying and crystal size is increasing with the substitution of $Mn^{2+}$. This indicates the thermodynamical stability of $Mn^{2+}$ in the spinel structure. The presence of ultrafine ferrite nanoparticles in the present ferrite systems is evident from the broad nature of XRD patterns. The nature of the hysteresis loops indicates the soft magnetic behaviour of ferrite. The unsaturated magnetic behaviour even at 20 kOe indicates that the particles are in superparamagnetic state possessing core-shell morphology. The ferrite nanoparticles having nanodimensions below critical size have high surface to volume ratio. Such nanoparticles have a capability to hold more charge for the storage. Highest value of saturation magnetization of 54 eum/g was reported in the present study. The results are interpreted in terms of cation redistribution presuming the possible core-shell interactions.

# Effect of particle size with the impact of annealing temperature on structural and dielectric property of spinel ferrite nanoparticles

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## Abstract

Nickel –cobalt ferrite nanoparticles have been prepared by evaporation method and the prepared powders were annealed at different temperatures (500˚ C and 900˚C).The effects of annealing of structural and dielectric properties are also analyzed .TEM image confirmed that particle size is below 30 nm .With increase in annealing temperature, the diffraction peaks become very sharp and narrow .This sharpness is also revealed as an increase in the crystalline property. The average crystalline size is predicted as 7.5 nm, 10.4 nm and 14.9 nm for nickel, cobalt and ferrite sample which are annealed at 500˚ C and 900 ˚ C. The variations of dielectric constant with respect to the applied frequency for different annealing temperatures are also observed. This trend is generally maintained for spinel ferrites. Thus annealing temperature played a major role in structural and dielectric property.

# Preparation, dopant effects and applications of Titanium oxide (TiO2) thin films - A short review

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**Abstract**

In this present era, transparent conductive oxides (TCO's) acquired greater attention due to their significant applications in the areas like solar cells, batteries, sensors, photocatalysis, photonics, magnetic and medical applications. Among these TCO's $TiO_2$ is one of the interesting compound and widely used due to their low cost, excellent chemical and mechanical stability, nontoxicity and high reactivity. Already many researchers reported the microstructural, morphological, optical and electrical conducting properties $TiO_2$. Also, to improve its electrical, optical, sensing and photovoltaic properties many dopant were added and the dopant influence were studied. In this short review we deliver a past, recent and future research activities related to the pure and doped TiO2 thin films.

# Synthesis and Characterization of $ZnO_2$ Nanoparticles by Microwave Irradiation Method

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## Abstract

The $ZnO_2$ nanoparticles had been successfully synthesized by microwave irradiation method. The XRD studies of the sample confirmed the formation of tetragonal structure. No impurity phase was observed in the XRD. The crystallite size and lattice constants were analysed. The XRD patterns show that the average particle size is in the range of 21 nm. The occurrences of hydroxyl ions were confirmed through FT-IR. The SEM result shows that the uniform distribution of morphology, nearly spherical shape. The presence of Zn and O peaks were confirmed through EDS analysis. The TEM pattern implies that the prepared $ZnO_2$ nanoparticles are some particles of spherical shape in the range of about 11-50 nm. The synthesized zinc oxide nanoparticles are widely used in gas sensor applications.

# Green synthesis, characterization and catalytic activity of Ag/keratin nanocomposite derived from goat horns

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## Abstract

Ag immobilized keratin nanocomposite (Ag-keratin) was successfully prepared by green synthetic method using *Moringa Oleifera* leaves extract as a reducing agent. To the best of our knowledge, this is the first report on the preparation of keratin nanoparticles from goat horns by ultrasonic-assisted green synthetic method. Excellent physical and chemical properties of keratin nanocomposites were investigated by means of various spectral, microscopic and analytical techniques. TEM and AFM results confirmed the efficient immobilization of Ag nanoparticles into keratin matrix. Oxidation state and crystalline nature of Ag was studied by XPS and XRD. Metal-keratin interaction was investigated by TGA and DSC. After being completely characterized, the Ag-keratin was used as catalysts for the reduction of 2- and 4-nitrophenol to aminophenol. To our delight, the resultant materials exhibited excellent catalytic activity toward the reduction of nitrophenols in water. We found that the reaction was rapid with excellent selectivity.

# Applications of Nano Chemistry

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**Abstract**

The greek word "NANO" means very small. Nano means "One billionth" $10^{-9}$. The most important property of nano particles is the surface area to volume ratio is high. Nanochemistry finds its application in electronics where high speed computers are made with structured semiconducting materials like silicon. Long durability paints can be made using silver nano particles, etc. Nano alumino silicates can be used as an environmentally safe pesticide. A Nano sensor finds its applications in pathogen detection, spoilage detection, etc. In military field for detection of explosives and toxic gases, magnetic nanobeads for continuous monitoring of interferons.

# Reinforcement of Aramid fiber applications of Proton conductivity studies

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## Abstract

Proton conductivity plays a key role in important processes as diverse as the photosynthesis in green plants and the production of electricity in a hydrogen fuel cell. Consequently, proton-transport and transfer phenomena have been studied extensively from rather different points of view by material scientists, chemists, physicists, and biologists.[1] unfortunately, the abundant data are rather heterogeneous, and the current understanding of the underlying elementary steps including their mutual interdependence is still in its infancy. Fuel cell is an electrochemical device, which directly converts chemical energy into an electrical energy by using various fuels such as methanol, hydrogen, natural gas, ethanol and glucose.[2] Supramolecular polymers comprise fascinating research field composite materials. Hydrogen bonded polyaramid fibers are received attention of the good mechanical and tensile properties.

# Solution Growth Synthesis of 2-aminobenzothiazolium-4-chlorobenzenesulphonate: Spectral, Thermal Analysis, Structural Elucidation and Biological Applications

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## Abstract

An organic charge transfer (CT) compound, 2-aminobenzothiazolium-4-chlorobenzenesulphonate (ABTCS) was synthesized by the reaction between 2-aminobenzothiazole and 4-chlorobenzenesulfonic acid and crystallized by slow evaporation of solution growth technique at ambient temperature. Single crystal X-ray diffraction analysis indicates that the grown crystal belongs to the monoclinic system with space group, $P2_1/c$. Spectral studies (1H,13C NMR, UV -Visible, FT-IR) were carries out to unravel the structure of ABTCS. Thermal stability of the compound was analyzed by thermogravimetric (TG) and Differential Thermal analysis(DTA). In other hand frontier molecular orbital (FMO), Mulliken charge distribution and thermodynamical properties were performed by density functional theory (DFT) at the B3LYP/6-31G and HF/6-31G basis sets. Further, the DNA binding activity of the title compound with calf thymus DNA (CT-DNA) was studied by the electronic absorption spectroscopic study. The DNA binding result reveals that the compound has considerable interaction with CT-DNA. Investigation of antioxidant properties showed that the synthesized compound has strong radical scavenging potencies.

# *Hibiscus rosa sinensis*arbitrated green synthesis of ZnO nanoparticles: structural and morphological studies

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**Abstract**

Green synthesis of multifunctional zinc oxide nanoparticles (ZnO Nps) was attained using water extract of *Hibiscus rosa sinensis* by solution combustion method. The structure and morphology were determined by XRD, UV–visible, PL, FT-IR, SEM, EDX and TEM. The ZnO Nps were evaluated for photoluminescence (PL), photocatalytic and antioxidant properties. The green extract was found to comprise significantly high amounts of polyphenols and flavonoids. XRD studies indicate the formation of pure wurtzite structure with absorption maximum of 370 nm corresponding to band gap energy of 3.33 eV. SEM studies reveal the formation of spongy cave like structures. The PL spectra exhibited 4 emission edges at 397, 436, 556 and 651 nm upon excitation at 325 nm because of oxygen deficiencies and zinc interstitials. ZnO Nps exhibit remarkable photodegradation of methylene blue (MB) in presence of UV and sun light. Therefore, the study reveals an efficient, ecofriendly and simple method for the green synthesis of multifunctional ZnO Nps.

# Synthesis and Characterization of Ytterbium Oxide Thin Films by Spray Pyrolysis Techniques for Al/$Yb_2o_3$/P-Si Schottky Barrier Diode Applications

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## Abstract

Ytterbium oxide ($Yb_2O_3$) thin films were deposited on glass substrate at various substrate temperatures, such as 350°C, 400°C, 450°C, 500°C and 550°C using spray pyrolysice technique. The effect of substrate temperature on the structural, surface morphology, compositional, optical and electrical properties of $Yb_2O_3$ thin films was systematically studied. X- ray diffraction pattern (XRD) shows that all the coated films are single crystalline in nature with cubic crystal structure. Field emission scanning electron microscope (FESEM) reveals that the $Yb_2O_3$ films consisting of uniformly distributed nano ball like cabbage structure over the entire surface of the substrates. Which are highly agglomerated at a higher substrate temperature. The presence of elements like Yb and O was confirmed through Energy Dispersive X-ray Spectrometer (EDAX) spectrum. The $Yb_2O_3$ thin films deposited with 450°C exhibited maximum band gap of $E_g$ =3.7 eV relatively with others. From the current-voltage (I-V) characteristics, the mean electrical conductivity was found to increase while the activation energy reduced with substrate temperature. The Al/$Yb_2O_3$/p-Si structured Schottky Barrier Diode has been fabricated with different substrate temperature. The experimental outcome of all parameters like ideality factor (n), barrier height (ΦB) values were calculated and interpreted based on the thermionic emission theory model.

# Rational Design of the Triphenylamine based Sensitizers with Narrow Band Gap for DSSCs: A First Principle Study

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**Abstract:**

The energy conversion efficiency of dye-sensitized solar cells derived from organic dye molecules has seen immense interest recently. In this work, we report a series of organic donor molecules with enhanced energy conversion efficiency using π-spacers and cyanoacrylic acid as an anchoring group. Density functional theory (DFT) and time-dependent DFT calculations of these molecules have been performed to examine their electronic structures and absorption spectra before and after binding to the semiconductor titanium dioxide surface. The computational results suggest that dyes TPA-$N(CH_2)_3$ have a larger driving force ($\Delta G_{inject}$ = -0.88 eV) and light-harvesting efficiency (LHE = 0.7715) in the series of donor molecules studied. Thus, these dyes should possess a larger short-circuit photocurrent density (Jsc) compared to the other examined dyes. In particular, the calculated results indicate that the TPA-$N(CH_3)_2$ electron donor modified group is strongly electron transfer for fast electron injection and dye regeneration, increasing the dipole moment, which results in a higher power conversion efficiency.

# Synthesis and characterization of Poly(m-phenylenediamine)/$NiFe_2O_4$ nanocomposites

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## Abstract

Poly(m-phenylenediamine) (PmPD)/$NiFe_2O_4$ nanocomposites were synthesized by in situ oxidative polymerization containing two different ratios of $NiFe_2O_4$ nanoparticles (10 and 20%). Magnetic measurements of $NiFe_2O_4$ nanoparticles and PmPD/$NiFe_2O_4$ nanocomposites showed that they have ferromagnetic behaviour at room temperature. The XRD patterns of PmPD/$NiFe_2O_4$ nanocomposites are confirming the incorporation of $NiFe_2O_4$ nanoparticles into PmPD polymer. The SEM image of PmPD shows sphere like morphology. TGA suggest that thermal stability of PmPD/$NiFe_2O_4$ nanocomposites is greater than PmPD. Dielectric studies of PmPD/$NiFe_2O_4$ nanocomposites were carried out at different temperature and frequency. Dielectric constants of PmPD/$NiFe_2O_4$ nanocomposites vary with the concentration of $NiFe_2O_4$ nanoparticles.

# Structural, morphological, optical and gas sensing properties of pure and Ce doped $SnO_2$ thin films prepared by jet nebulizer spray pyrolysis (JNSP) technique

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## Abstract

Pure and cerium (Ce) doped tin oxide ($SnO_2$) thin films are prepared on glass substrates by jet nebulizer spray pyrolysis (JNSP) technique at 450 °C. The synthesized films are characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive analysis X-ray (EDAX), ultra violet visible spectrometer (UV-Vis) and stylus profilometer. Crystalline structure, crystallite size, lattice parameters, texture coefficient and stacking fault of the $SnO_2$ thin films have been determined using X-ray diffractometer. The XRD results indicate that the films are grown with (110) plane preferred orientation. The surface morphology, elemental analysis and film thickness of the $SnO_2$ films are analyzed and discussed. Optical band gap energy are calculated with transmittance data obtained from UV-visible spectra. Optical characterization reveals that the band gap energy is found decreased from 3.49 to 2.68 eV. Pure and Ce doped $SnO_2$ thin film gas sensors are fabricated and their gas sensing properties are tested for various gases maintained at different temperature between 150 and 250 °C. The 10 wt. % Ce doped $SnO_2$ sensor shows good selectivity towards ethanol (at operating temperature 250 °C). The influence of Ce concentration and operating temperature on the sensor performance is discussed. The better sensing ability for ethanol is observed compared with methanol, acetone, ammonia, and 2-methoxy ethanol gases.

# Synthesis, Growth,Spectral, Thermal, Mechanical and Structual Characterization and Bilogical Investication of a New Organic Salt Crystal:4 - Chloroanilinium-3-Carboxy-4-Hydroxy Benzene Sulphonate

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**Abstract**

A through literature survey on organic salt crystals containing 3- carboxy -4-hydroxybenzenesulphonic acid with organic bases indicated that only a little work has been done so far on these salts and few reports are available are in the literature. Moreover detailed reports on spectroscopic, thermal, structural and mechanical studies were not carried out on these salts so far. Hence, based on these aspects we attempted to prepare the salt of 3- carboxy-4- hydroxybenzenesulphonic acid with 4- CHLOROANILINIUM-3-CARBOXY-4-HYDROXY aniline. Our attempts culminated in the successful synthesis and growth of single crystals of this salt.

The organic salt , 4- CHLOROANILINIUM-3-CARBOXY-4- HYDROXY BENZENE SULPHONATE was synthesized and grown into single crystals by slow solvent evaporation solution growth method at ambient temperature. The molecular structure was established by single crystal XRD analysis. Further, the data indicate that the title crystal belongs to monoclinic crystal system with centrosymmetric space group, P21/C.The THERMAL stability of the crystal was established by TG/DTA analysis. The mechanical strength of the crystal was found out Vickers micro hardness study which reveals the soft nature of the CBS Crystal. In addition, the crystal has been subjected to evaluate it's antimicrobial and antioxidant properties. The antioxidant activities indicate that the compound could serve as a potential antioxidant against DPPH radical and has high Ferric reducing antioxidant power (FRAP).

# Enhanced property of POT / n - $V_2O_5$ in antimicrobial studies

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## Abstract

Hybrid polymer nanocomposites gains research interest since from the past decade. These composite materials are of their component materials occupying its structural matrix. In the present work, a series of polymeric nanocomposite samples 'POT $V_2O_5$' has been synthesized using poly(o-toluidine) (POT) with incorporations of vanadium pentoxide of different quantities in terms of 25,50 and 75 Wt.% employing in situ chemical oxidative polymerization method.Primary objective of the present work is to focus the suitability of synthesized nanocomposite samples for biomedical issues. Hence, the aqueous stability, morphological features and antimicrobial characteristics have been investigated employing appropriate characterization techniques such as scanning electron microscopy (SEM), Energy dispersive x-ray analysis (EDAX), dissolution studies and antimicrobial analysis. The observed morphological studies explored the surface roughness in samples and they are reducing with increasing quantity of $V_2O_5$. From EDAX analysis, elemental concentrations as increasing the additive content $V_2O_5$. From antimicrobial behavioral the size of inhibition zone for all three 'POT $V_2O_5$' is same for *E. coli* bacteria, observed zone of inhibition size slightly reduces with increasing $V_2O_5$ content in *S. Aureus.*The observed dissolution study results recorded the increase in aqueous stability of POT $V_2O_5$ samples with increasing $V_2O_5$ content.

# Synthesis and Characterization of Cadmium Oxide Nanoparticles by Powder Method

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**Abstract**

The $CdO_2$ nanoparticles have been successfully synthesized by co - precipitation method. The Powder X-ray diffraction pattern of the nanocrystalline $CdO_2$ shows that the sample possesses cubic structure with average crystallite size in the range of 14 nm for annealed temperature at 400°C. SEM results show both the presence of agglomeration and non agglomeration of the smaller crystallites. The EDS result exhibits the presence of Cd and O by the appearance of Cd and O peaks. This is the simple synthesis method and they are used to optical and gas sensor applications.

# Metal Incorporated Multiphase Nickel Oxide Nanocomposites

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**Abstract:**

Uniform and well-dispersed hexagon shaped metal (Ce, Cu, Gd, Mn, Yt) doped nickel oxide multiphase nanocomposites are prepared by precipitation technique. The structural, optical, morphological and magnetic properties of the composites are investigated. XRD and FT-IR results reveals the existence of metal ions in nickel oxide lattice structure. All the NiO based nanocomposites having multiphase crystal structures with high degree of crystallinity. The prepared NiO nanocomposites exhibits four strong and broad absorption bands at 260,380, 420, and 720 nm in the UV and visible region due to nanocrystalline phases of NiO, CuO, CeO, and MnO. TEM result demonstrated that the samples prepared from Gd & Y shows the formation of smooth surface, while the same prepared from Ce & Mn indicated rough surface. The magnetization curves of the samples prepared from Cu, Mn, & Gd based NiO nanocomposites exhibit ferro magnetic behavior, whereas the same prepared from Ce and Y based nanocomposites posses superpara magnetic behavior. The secondary phases would affect the magnetic properties of the samples which changes the magnetization reversal mechanism (ferromagnetic to superparamagnetic). Therefore, NiO nanocomposites prepared with different doping elements are generally regarded as Diluted magnetic semiconductors (DMS), and are an important class of materials used for spintronic devices.

# Role of Oxidant to Fuel Ratio on $ZrO_2$ :(0.01)$Ce^{3+}$ Structural and luminescent Properties *via* Solution Combustion Synthesis

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**Abstract**

Solution combustion synthesis is one of the novel and efficient technique among the available methods used to prepare nanoparticles, multi-component ceramic oxides and composites with improvised properties better than conventionally prepared one and also these materials have been used for various applications such as sensors, catalysts, and materials for solid oxide fuel cell (SOFCs). In this work, SCS method was adopted to prepare nanoparticles of $ZrO_2$: 1 mol % $Ce^{3+}$ with oxidant to fuel (O/F) ratio such as 0.5, 0.75, 1.00, 1.25, 1.50, 1.75 and 2.00. Different O/F ratios were found to affect the powder structural and luminescent properties and even compositional homogeneity. PXRD results show the existence of multiphase in the sample. SEM micrograph exhibit considerable changes when changes in O/F ratios. Emission spectra of all samples recorded in the range between 400 – 650 nm, when excited at 395nm which corresponds to excitation of $Ce^{3+}$ situated in the $ZrO_2$ matrix. Strong peaks were observed at 445 (blue emission) and also maximum emission intensity observed for O/F ratio equal to 1. So, Efficient blue light emitting diodes were fabricated using $Ce^{3+}$ doped phosphor based on near ultraviolet (NUV) excited LED lights. Also the prepared phosphor was useful for sensing application such as biological and chemical sensing.

# Transmission Line Multiple Fault Detection and Indication to Electricity Board

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## ABSTRACT

In this paper, a scheme for fault detection and identification of SIGNLE PHASE overhead transmission lines is proposed. Fault detection techniques based on mean square value of the difference between incoming and out going single phase currents of each section. These differences are compared against threshold setting values. Faulty phase identification is based on the analysis of single phase currents at one end of transmission line. The transient currents are processed by Discrete Wavelet Transform multi-resolution analysis. It is used as input to a rule-base system to identify the fault type. Many case studies are provided to validate the proposed algorithm.

# Photocell Technology to Acheve Global Energy Goal

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**Abstract**

A smart home is a residence equipped with technology that observes the residents and provides proactive services. Most recently, it has been introduced as a potential solution to support independent living of people with disabilities and older adults, as well as to relieve the workload from family caregivers and health providers. One of the key supporting embedded processors, current smart homes are typically equipped with a large amount of networked sensors which collaboratively process and make deductions from the acquired data on the state of the home as well as the activities and behaviors of its residents. This article reviews sensor technology used in smart homes with a focus on direct environment sensing and infrastructure mediated sensing. The proposed research also points out the strengths and limitations of different sensor technologies, as well as discusses challenges and opportunities from clinical, technical, and ethical perspectives. It is recommended that sensor technologies for smart homes address actual needs of all stake holders including end users, their family members and caregivers, and their doctors and therapists. More evidence on the appropriateness, usefulness, and cost benefits analysis of sensor technologies for smart homes is necessary before these sensors should be widely deployed into real-world residential settings and successfully integrated into everyday life and health care services.

# Battery with ultrafast and high-capacity Na-ion storage

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## Abstract

Sodium-ion batteries are a potentially low-cost and safe alternative to the prevailinglithium-ion battery technology. However, it is a great challenge to achieve fast charging andhigh power density for most sodium-ion electrodes.This is due to the larger size and higher m/e ratio of the sodium ion compared to lithium, sodiation reactions of candidate electrodes are expected to differ in significant ways from the corresponding lithium ones. In this case, sodiation reaction becomes sluggish. Here we demonstrate a high-capacity and high-rate sodium-ion anode based on ultrathinlayered tin(II) sulfide nanostructures. To the best ofour knowledge, our purposely engineered SnS Nano honeycombstructure exhibits the highest reversible capacity, rate capabilitycompared with the reported carbon allotrope, metal/alloy andmetal oxides/sulfides as SIB anodes. Thus a maximized extrinsic pseudocapacitancecontribution is identified and it is verified by kinetics analysis. The graphene foam supportedtin(II) sulfide Nano array anode delivers a high reversible capacity, which even outperforms its lithium-ion storage performance. The surface-dominated redox reaction rendered by our tailored ultrathin tin(II)sulfide nanostructures may also work in other layered materials for high-performance sodium-ion storage. It is widely believedthat sodium-ion transport and storage are more sluggish with more severe lattice expansion than the lithium ion one because of the larger radius of sodium-ion. The polarization from 30 to 7 mA/gduringLithiation is twice to that in sodiation. Finally, the sodiation discharge curves have more moderate and continuous operation voltage than thelithiation ones, which is favorable to achieving highenergy density of full cells.

# Design and Modification of E-Bike

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**Abstract**

This work presents the design and fabrication of E-bike. The existing e-bike design has facing the problems of over loading, insufficient power while travelling on up hills, low speed application, system complexity and battery-backup system. In order to overcome these problems, a modified mechanical structure based E-bike is going to be designed. The developed model comprises of both mechanical system and electrical system. Here, the mechanical system indicates the structure design, wheel design (front and rear wheel), chain drive design and welding process. The electrical system consists of a brushless DC motor, control unit, throttle, change over switch, braking system, Hall Effect sensor and a battery which acts as the source for BLDC drive. The main benefits of the model have minimum cost, elimination of pollution, clean environment and proficient efficiency. The performance of the designed model is going to be validated by making the prototype model at various distance operating conditions.

# Smart Scientific Cultivation Using Hydroponic Automation

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**Abstract**

The main focus of this project is to make hydroponic plant growing easier. Hydroponics is derived from the Latin word "hydro" means water and "ponos" means labor. Hydroponic is the method of growing plants without use of soil. This method is used to growing plants using mineral solutions instead of soil. These plants has to grow with their roots with the help of nutritious liquid. This is the method of growing plants with rich nutrition in water. A plant just needs selected nutrients water and sunlight to growth. Hydroponic generally eliminates pesticides. Water used in hydroponic cultivation can be reused and reduce the continuous need for fresh water. Water related micro-organism can be reduced by monitoring and controlling of plants. PH level of water solution will be automatically maintained by microcontroller and measured by sensor. Period of pH level started to change and its effects of pH adjuster water solutions are determined. This also focuses on the ability of the system can adjust the pH value in water solution. Temperature of water can be monitoring continuously with the help of sensors. Electrical conductivity of water and concentration of nutrients in water are measured and monitored. Growth of hydroponic plants can be faster rate. The main advantage of this project is conservation, reduce the usage of ground water and create awareness about recycle of water, used for irrigation.

# An Investigation on Microstructure and Mechanical Properties of Groundnut Shell Ash, Boron Carbide and Aluminium Metal Matrix Composites

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**Abstract**

Materials with good strength to weight ratio are becoming very essential in modern engineering designs especially for automotive and aerospace applications where improved machine efficiency and reduced fuel consumption are critical requirements to be satisfied. Also, modern infrastructures, equipment and machineries that are currently developed require materials that have a good combination of properties to match service demands. Aluminium matrix composites(AMCs) represent a class of materials that offer a wide range of properties that can measure up with the design requirements of some of the aforementioned applications AMCs are primarily reinforced with fibres or particulates which are usually ceramic materials (SiC, $Al_2O_3$, WC, $B_4C$, $TiO_2$, BN).They can be produced via solid route processing (such as powder metallurgy) and liquid metallurgy processing routes (rheocasting, compocasting, liquid infiltration, stir casting are a few examples) Without disregard to the technical competence of other processing routes available, stir-casting remains the most utilised technique due to its simplicity, flexibility, low cost acquiescence and commercial viability. Over the years, single reinforced composites have been mostly developed for use in several applications but have been observed to have some material property and cost related limitations. Efforts to optimise the performance of single reinforced MMCs and also to reduce the processing cost have paved way for the development of hybrid reinforced AMCs.

# Intelligent Stick for Visually Challenged People

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**Abstract**

This project is about to design intelligent stick for blind persons. Visually impaired people find difficulties to detect obstacles in front of them, during walking. This smart stick comes solution to enable them to identify the world around. This stick is designed with ultrasonic sensor to detect any other obstacles in front of the user; moisture sensor is used to detect the water and mud surface. Warning messages are activated when the obstacles or water are detected. This stick is capable for detecting all obstacles in the range of 4 meters in front of it and gives a suitable respect message empowering blind to move away from obstacles. The voice analyzer is used in the stick for communication. This intelligent stick is of fast response, low power consumption and light weight in nature.

# Design of Coreless Axial Flux Generator For Rural Electrification

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**Abstract**

Different types of generator are being used in wind power technology .This work represents the coreless axial flux permanent magnet generators used for low cost wind power applications .Also suitable for rural electrification process and designed for direct battery charging or grid connection. Implementing the generators in small wind turbines by calculating the design parameters. By using this type of generators ,there is improvement in efficiency of wind power generation system with variable speed operation and better wind power utilization. Usage of coreless permanent magnet synchronous generator have overcome the demerits of cored permanent magnet synchronous generator as this provides good ventilation. The result of coreless design is reduction of overall mass of generator .As the design of these generators yield high energy.

# Mechanical characteristics evaluation of Natural fibre reinforced composites: A review

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**Abstract**

In recent years, natural fibers with composites are useful in the field of research, Engineering and Science as well it is used as an alternative reinforcement for conventional composite. Natural fibers are not only strong and light weight, but also relatively cheap and have properties like high specific strength, low weight, nonabrasive, eco-friendly and biodegradable. The environmental problems associated with the production, disposal and recycling of synthetic fibre based polymer composites has prompted the development of eco-friendly natural fibres. It involves use of kenaf, jute, oil palm, cotton, flax, banana, hemp, sisal and pineapple leaf fibre (PALF) for various applications such as automotive, infrastructure, biomedical, furniture, packaging etc are gaining attention as they are abundantly available, cheaper, eco-friendly and possess remarkable and satisfactory mechanical properties This review paper deals with the mechanical properties evaluation of natural fibre composites and several factors influencing properties such as type of variety, fibre length, matrix type, fibre orientation, voids and porosity content This review article aims at the clarification of the research and development in the improvement of mechanical properties of natural fiber reinforced composites along with end applications. Attempt also been made to investigate the effect of water absorption, chemical concentration, exposure time, filler weight% and individual fibre loading % in the hybrid configuration on the mechanical properties.

# Smart Sewage Poisonous Gas Analyzer and Controller Using Iot

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## ABSTRACT

In this paper we are going to investigate and improve about recent trends in drainage system and safety measures to be taken for improve the drainage system without any unfortunate issues. Now a day's our public and workers in drainage area facing lots of problem due to the irregular maintenance by human. Another problem for which our government doesn't take any drainage purification process as past few years many workers lost their life within the drainage because of the presence of hazardous gases due to without proper safety measure and investigation about the drainage waste. To overcome this problem a new automation device has been developed that is able to monitor and removal the poisonous gases from sewage water . If the level of the gas exceeds then the device by using IOT based devices and advanced equipments will give us an indication through which the workers can take safety measures immediately. Major chemical solutions are used to control the poisonous gases in the system.

# An Investigation of Machinability and Surface Integrity on Aluminium, Boron Carbide and Groundnut Shell Ash Using Abrasive Water Jet Machining

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## Abstract

Metal Matrix Composites (MMCs) are materials that offer tailor-made property combinations required for wide range of engineering applications. MMCs are composed of a soft metal matrix and hard reinforcing particles. In hybrid composites two or more reinforcement materials with different properties are mixed at molecular level in continuous metal matrix phase and these composites are more homogeneous than the traditional composites and offer improved properties. Cutting force arises as a major problem in machining of Metal Matrix Composites using conventional machining owed to the presence of reinforcement materials. Hence a non-conventional machining process namely Abrasive Water Jet Machining (AWJM) is preferred. The cutting parameters such as pressure, standoff distance (SOD) and feed rate are analyzed based on the $L_{27}$ orthogonal array and the machining parameters such as kerf angle, SR and MRR will be intended. The sub-surface element like residual stresses will also be investigated through the depth profile for both types of turning process by means of XRD machine. This paper reviews machining investigation of various hybrid MMCs in terms of process parameters used, and their influences on machining performance, modelling and optimization of the processes, techniques used, their efficiency and summary of the review will be shown.

# Floating Power Station 'Mars' the Future Windmill

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## Abstract

High altitude winds are considered to be, together with solar energy, the most promising renewable energy source in the future. The concepts based on kites or air foils are already under development .In this paper the concept of transferring kinetic energy of high altitudes wind to mechanical energy by exploiting Magnus effect on airborne rotating cylinders is presented, together with corresponding two-dimensional per module aerodynamic and process dynamic analysis. The concept is based on a rotating airborne cylinder connected to the ground station with a tether cable which is used for mechanical energy transfer. Helium sustains the Air Rotor which ascends to an altitude for best winds and its rotation also causes the Magnus effect. The cylindrical MARS unit is filled with helium, which provides the lift necessary to keep it in air additional lift is provided by Magnus effect where a rotating object in air can also generate lift for itself .this effect also enables the unit to stay in place, rather than constantly drift download. Once the wind passes over the unit, electricity is generated by rotation of MARS unit, and it is then transferred by cables to the ground into a transformer. Performed studies have shown the positive correlation between the wind speed and mechanical energy output. The main conclusion of this work is that the presented concept is feasible for power production.

# Preparation and Characterization of Gd:Cu Nanocomposites

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**Abstract:**

Flower shaped Gadolinium doped copper oxide dual phase nanocomposites are prepared by precipitation technique. The prepared composites are characterized by XRD, UV-DRS, FT-IR, SEM and IV. XRD pattern confirms the occurrence of dual phase polycrystalline cubic and monoclinic crystal structure with dominant orientations along (222) and (002) reflection. The composites attain amorphous nature at higher Gd concentration due the appearance of new peak (121). Strong and sharp absorption peaks are observed for pure copper and gadolinium samples while the weak absorption peaks are obtained for mixed nanocomposites due to the presence of new phase $GdCu_2O_4$ according to XRD results. The highest band-gap (4.03 eV) is obtained for rare earth material Gd whereas the lowest band-gap (2.44 eV) is obtained for metal copper. The electrical conductivity increases with the incorporation of Gd which leads to the reduction of band gap.

# Structural, optical and antibacterial activities of ZnS nanoparticles: application of drug release behaviour

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**Abstract**

Optical and structural properties of Zinc sulfide (ZnS) nanoparticles have been successfully prepared by sol-gel precipitation method. The x-ray diffraction showed the cubic structure of all the samples taken in the study. The crystallite size increases along the (111) plane with temperature ranges from 150°C to 200°C and attains a maximum peak at36 nm in 200 °C. TEM images revealed the formation of agglomeration of particles and SAED pattern obtained indicated polycrystalline nature. SAED pattern was calculated in lattice parameters of the samples which have close resemblance of XRD pattern. The band gap value ZnS nanoparticles were calculated by UV visible absorption and reflectance spectra of luminescence. The band gap ZnS nanoparticles was obtained between 3.58 to 3.59 eV. Photoluminescence spectra of ZnS nanoparticles showed an emission at 368 and 428 nm. The nano composites were investigated for drug release behaviour and found to be ZnS nanoparticles were also found to be antibacterial agent Escherichia coli and staphylococcus aurous. The obtained ZnS exhibited high performances in prohibiting the growth of Escherichia coli (MG1655) and staphylococcus strain and negligible mammalian cell, and theses important feature makes it an antimicrobial agent for controlling implant-related infections.

# The Preparation of Manganite ($Mn_3O_4$) Nanoparticles in Sol Gel Process

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**Abstract:**

Manganite ($Mn_3O_4$) preparation is initiated by different liquid phase process. Also different parameters like concentration, annealing temperature, pH are included in the synthesis. The thermal treatment (400 $^oC$ to 900 $^oC$) and varying the mole percentage of manganese (0.5 M to 2 M) in both cases $Mn_2O_3$ phase is formed instead of manganite which is confirmed by X-ray diffraction (XRD). The crystallinity with cubic structure of $Mn_2O_3$ nanoparticles were confirmed by XRD pattern. The problems faced are discussed about the synthesis of manganite. Also, the obtained $Mn_2O_3$ phase during the various attempts is further characterised using FTIR, FESEM, TEM and VSM.

# Structural and magnetic characterization of sol-gel auto-combustion $Ni_xZn_{1-x}Fe_2O_4$ ferrite nanoparticles

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**Abstract**

A Ni-Zn ferrite powder was synthesized by sol-gel auto combustion process. This process is convenient, inexpensive and an efficient method for the formation of nanomaterials. The particle size and magnetic properties has been investigated by various techniques.XRD and FTIR studies reveal the formation of spinel phase of ferrite samples. The magnetic properties measured using a vibrating sample magnetometer revealed high magnetization saturation level of 52 emu/g observed at room temperature. Mossbauer studies measured at room temperature had witnessed the existence of $Fe^{3+}$ ion and absence of $Fe^{2+}$ ions in the present system. These super magnetic nanoparticles supposed to be potential candidates for targeted drug delivery, cancer treatment by hyperthermia.

# Structural and electrical properties of Iron doped $V_2O_5$ nanoparticles

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**Abstract**

$V_2O_5$ and $Fe_xV_2O_5$ nanostructures have been synthesized by a wet chemical method. The synthesized nanostructures have been characterized by XRD, SEM-EDX, HRTEM, AC and DC conductivity study's. The XRD patterns of undoped and Fe doped samples prepared at low temperature showed that the samples have anorthic phase. This anorthic phase is reduced in the annealed samples at 600$^o$C for 1h and then transformed into orthorhombic phase. It was evident that the substitution of Fe changed the surface morphological from micro-rod to nanorods network. The AC and DC conductivity measurements made on the disk shaped pellets at room temperature to different temperatures (303-403K), revealed that the activation energy for the electrical transport is high for Fe doped $V_2O_5$ than undoped $V_2O_5$.

# Structural, morphological and optical properties of pure $SnO_2$and Yttrium doped $SnO_2$ (YTO) thin films by Nebulizer Spray Pyrolysis (NSP) technique

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**Abstract:**

Tin oxide ($SnO_2$) thin films doped with different concentrations of Yttrium (Y) were deposited on the glass substrates at 450°C by Nebulizer Spray Pyrolysis (NSP) technique. The structural, morphological and optical properties of thin films were investigated by XRD, SEM, EDS and UV-Vis techniques. X-ray diffraction pattern confirms the tetragonal crystal structure for pure and Y doped tin dioxide thin films. Scanning electron microscopy shows the modification of surface morphology of tin oxide films due to varying concentration of yttrium. Energy dispersive analysis reveals the average atomic percentage of pure and Yttrium doped $SnO_2$ (YTO) present in the films developed. Optical studies divulge that the band gap energy decreases from 3.55 eV to 3.16 eV due to the increased Y concentrations.

# Impact of sintering temperature on Structural and Electrical properties of In substituted $CuFe_2O_4$ Nanoparticles

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## Abstract

In substituted Cu ferrite nanoparticles were synthesized by chemical co-precipitation method and the samples were sintered at 600 °C, 900 °C. The effect of sintering at two different temperatures was studied and analyzed using XRD, SEM, UV, I-V measurements. XRD results show an increase in crystallite size and also decrease of lattice parameter owing to sintering temperature. The band gap energy values can be attributed to direct band gap absorption. The maximum conductivity was found to be in the range of 600 °C.

# Structural and Electrical Properties of Li substituted $CuFe_2O_4$ Nanoparticles

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## Abstract

Li substituted Cu ferrite nanoparticles were synthesized (X=0.2, 0.4) by chemical co-precipitation method. The above synthesized samples were sintered at different temperatures. From XRD analyses, the crystallite size is increased with respect to sintering temperature. The super imposition of bright spots confirms the polycrystalline nature form TEM analysis. The electrical conductivity is increased with increase of Li composition. From the I-V results, the electrical properties of the synthesized material are powerfully influenced by sintering temperature and also Li concentration.

# Optimization of nickel doped tin oxide chemoresistive sensor Ni-$SnO_2$ using carbon dioxide gas and humidity

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**Abstract**

we report the gas and humidity sensing properties of pristine tin oxide and nickel doped tin oxide sensor. The concern materials have been synthesized using microwave-assisted method. The structural and optical properties of the material has been studied using X-ray diffraction (XRD), scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Ultraviolet spectrum (UV) , FT-IR spectroscopy, X-ray photoelectron spectroscopy (XPS). The XRD of pristine and nickel doped tin oxide nanoparticles reveal their size of 32 – 46 nm and tetragonal rutile structure. The prepared nanoparticles have nanocrystalline nature with small cauliflower structures. The sensing properties of material were tested under the carbon dioxide gas and humidity. Both of the study reveals rapid sensing nature. Although, the materials favours gas sensing because their sensitivity was flourished even the increase of nickel concentration. The outcome of the sensing results suggests that nickel doping was effective metal additives to increase the gas sensitivity of the sensor.

# Temperature dependence on $Co_3O_4$ nanoparticles and development of batteries

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**Abstract**

In this work nanostructured $Co_3O_4$ samples have been synthesized successfully by a precipitation method at different temperature from 300 to 600 $^oC$. The prepared samples are characterized by X-ray diffraction (XRD), transmission electron microscope (TEM), Fourier transform infrared (FTIR), photoluminescence (PL) spectroscopy and ultra violet (UV) spectroscopy, respectively. The as-prepared $Co_3O_4$ nanoparticles appear to be a cubic crystal structure with average crystalline size 25 nm at 600$^oC$. The morphology and grain size of the $Co_3O_4$ sample were analyzed by TEM. Results show that smaller particles and more uniform $Co_3O_4$ sample with average particle sizes in the range between 12-25 nm for at 600 $^oC$. The luminescence property of the $Co_3O_4$ samples studied by the emission properties confirms the presence of defect levels caused by the oxygen vacancies. FTIR studies reveal weak complex vibrations between the Cobalt and oxygen species. Optical reflectance measurements indicate the decrease of band gap energy from 3.5 eV to 2.75 eV.

# Investigations on Properties of L-Proline Doped Imidazolinium L-Tartrate (Imlt) Crystals

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**Abstract**

Imidazolinium L-tartrate (IMLT) crystals and L-proline doped IMLT crystals were grown by slow cooling solution growth technique. The powder X-ray diffraction technique reveals the lattice parameters and strains developed due to the doping of L-proline in molar concentration. The transmittance spectrum unveils the contribution of the dopant atoms in the optical property of the grown crystals. Band gap and cut-off wavelength get affected by the increase in the dopant concentration. The vibrational frequencies and their characteristic bonding present in the grown crystals are given in the FTIR spectroscopy. The dielectric constant and dielectric loss of pure and L-proline doped IMLT crystals with respect to the frequency of the applied electric field have been investigated by the dielectric measurements. The surface morphology of the grown crystals was examined by the etching study it reveals the growth mechanism of the pure and L-proline doped IMLT crystals. The percentage of carbon, hydrogen and nitrogen elements present in pure and L-proline doped IMLT crystals was disclosed using CHN analysis. The third order nonlinear susceptibility was calculated from the nonlinear absorption coefficient and nonlinear refractive data obtained from Z-scan analysis.

# Synthesis and Growth of pure and L-threonine doped L-tartaric acid-Nicotinamide of nonlinear optical single crystals

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**Abstract**

A new series of organic nonlinear optical single crystals of pure, 1 mol% of L-threonine doped L-tartaric acid-nicotinamide (LTN) was synthesized and its single crystals were developed from their aqueous solution by a slow cooling method. Powder x-ray diffraction (PXRD) analysis shows that the grown crystals belong to the monoclinic crystal structure with the space group $P2_1$. Respective values of crystallite size, strain and dislocation density have been calculated using PXRD data. L- threonine in grown crystals of LTN was confirmed by CHN analysis. The UV–Vis–NIR spectrum of pure and L-threonine doped LTN crystals indicates good transmission and less optical absorption over the entire visible range, allowing its potential use in optical applications. The optical band gap was calculated and found to be increase with dopant concentrations of LTN respectively. The vibrational mode of different molecular groups in pure and doped LTN single crystals was identified by FTIR spectral analysis. Micro-hardness study on the crystals revealed that the hardness number ($H_v$) was found to increase with the applied load. The growth pattern of the crystals were analyzed through etching analysis at different etching durations (10 and 20 s), from which it is clear that the etch pit size was found to increase with an increase in the etching time. Second harmonic generation (SHG) property was confirmed by the Kurtz-Perry technique with the observation of emission of green light, when irradiated with 1064 nm fundamental of IR radiation.

# Room temperature ferromagnetism of co-doping Zn and (Ni - Mn) on the Tin oxide nanoparticles

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**Abstract**

Room temperature ferromagnetism [RTFM] in tin oxide nanopowders can be induced by introducing Ni and Mn ion in Zn- doped $SnO_2$ lattice. $Sn_{1-x}Zn_xO_2$ (x = 0.10) and $Sn_{2-(x+y)}Ni_xMn_yO_2$ (x = y = 0.10) nanopowders were synthesized by inexpensive sol-gel method. The influence of doping Zn and (Ni,Mn) – co-doping on structural and magnetic properties of $Sn_{1-x}Zn_xO_2$ [x = 0.10] and $Sn_{2-(x+y)}Ni_xMn_yO_2$ [x = y = 0.10] nanopowders is systematically investigated in this paper. X-ray diffraction reveals that samples are pure rutile-tetragonal phase. No impurity phase was detected in XRD patterns of Zn doped tin oxide and (Ni, Mn)-co-doped tin oxide nanopowders. The structure factor calculation reveals that the ions have been incorporated in the $SnO_2$ lattice. It has been observed from the TEM images that all samples show crystalline nature of nanoparticles. Magnetic investigation demonstrates that magnetic property strongly depends on codoping of ions. A systematic increase in magnetic moment at room temperature was observed with coercive field of 480-1049 G in the case of $Sn_{2-(x+y)}Ni_xMn_yO_2$ (x = y = 0.07 to 0.10) nanopowders synthesized at 450 $^oC$.

# ZnO nanoparticles via green waste conversion using fruit peel powder for dye removal application

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**Abstract:**

The present study focused to evaluate the utility of fruit peel waste material for the development of activated carbon and ZnO nanoparticles for water treatment applications. Green synthesized Activated Carbon and ZnO nanoparticles using fruit peel as a substrate was characterized using different techniques including FESEM, TEM, EDX, XRD and FTIR. In addition, further investigation was carried out to find their efficiency of its application for removal of selective dyes such as Congo red, Methylene orange and Malachite green in aqueous solution through adsorption and photocatalytic activity respectively. Green synthesized ZnO nanoparticles exhibited efficient photocatalytic activity of 70-98% against above mentioned selective dyes under the sunlight irradiation for the experimental condition which contains 20 mg of ZnO-NPs and 50 mL (30 mg L-1) of each dye solution. Further studies are recommended to elucidate the detailed mechanism of this fruit peel powder in proposed materials conversion and using these materials as an agent for dye removal applications.

# Structural, magnetic and gas sensing properties of Zn -cobalt and nickel ferrite nanoparticles

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## Abstract

Zinc substituted $MFe_2O_4$ nanoparticles (M= Co, Ni) have been prepared by a simple evaporation method and the prepared powders were annealed at different temperatures (600 °C and 900 °C). The role of Zn substitution on structural, magnetic, dielectric and gas sensing properties are also analyzed and the obtained results are discussed. The phase of the prepared nanoparticles is more influenced by annealing temperature. The effects of annealing temperature on magnetic properties of Zn substituted Cobalt and Nickel ferrite nanoparticles are also investigated. The prepared nanoparticles were subjected to the gas sensor measurement for different aspects. Liquefied petroleum gas sensing investigations of the prepared samples demonstrate that the Zn substituted $NiFe_2O_4$ possesses an improved response than Zn substituted $CoFe_2O_4$ nanoparticles.

# Photoelectrochemical behaviour of pulse electrodeposited $AgGaS_2$ films

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## Abstract

$AgGaS_2$ films were pulse electrodeposited on tin oxide coated glass substrates at different duty cycles for the first time. $AgGaS_2$ films were deposited on tin oxide coated conducting glass substrates at different duty cycles, in the range of 6 – 50 % at a deposition potential of - 1.14 V (SCE). The films were single phase with orthorhombic structure. Optical absorption measurements indicated a band gap in the range of 2.35 eV to 2.57 eV with decrease of duty cycle. The films exhibit p-type conductivity. The magnitude of the resistivity increased from 400 ohm cm to 900 ohm cm as the duty cycle is increased. The room temperature mobility increased with duty cycle and the carrier density decreased with increase of duty cycle. Photoelectrochemical (PEC) cells were prepared using the films heat-treated at different temperatures. The electrolyte was 1 M polysulphide. After photoetching, the following photovoltaic parameters were obtained, $V_{oc}$ of 0.6 V, $J_{sc}$ of 7.5 mA $cm^{-2}$, conversion efficiency of 4 %.

# Photoelectric and photovoltaic response of Fe doped ZnO nano rods by simple dip coating method

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## Abstract

One-dimensional zinc oxide (ZnO) nanorods have excellent electron mobility and exhibit great potential for photoelectric or photochemical applications. In this work, Fe doped ZnO nanorods have been successfully synthesized on ITO substrate via solgel dip coating method without using any catalyst. The photoluminescence studies revealed that electrons transition from a shallow level of Zn to top level of valance band increased, while near band edge (NBE) emission has been reduced with increasing Fe content, which indicated that Fe doping introduce some impurity levels and/or influence on the existing levels and hence affect the type of transition. The I–*V* measurements showed that resistance has been increased with increase in Fe-doping due to increase carrier concentration confirmed existence of Fe ions in valance state. The photo responsively of UV photodetectors based Fe doped ZnO nanorods demonstrated an increase trend with Fe doping.

# Investigation of structural and optical properties of ZnO nanostructures thin films of different thickness grown by electro deposition method

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## Abstract

ZnO nanostructured thin films have been prepared by simple and low cost electrodeposition method. In this paper, we investigated the effect of ZnO thin film thickness on structural, surface morphology and optical properties of ZnO thin films. The prepared thin films have been characterized by X-ray diffraction (XRD), Atomic force microscopy (AFM), UV-visible (UV–Vis) and Photoluminescence (PL) spectroscopy. X-ray diffraction confirms the formation of crystalline c-axis orientated hexagonal wurtzite structure of ZnO nanostructured thin films. Atomic force microscopic depicts that roughness and grain size of the ZnO films increase with increase in the films thickness. The direct optical band gap of the ZnO films calculated using Tauc's plot increase from 3.30 eV to 3.34 eV as the thickness of the films varies from 55 nm to 200 nm. The high quality c-axis orientated ZnO thin films with minimum strain and tunable optical properties could be used as an indium tin oxide (ITO) for optoelectronic applications.

# Advanced High-Entropy Alloys

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## Abstract

Steels are the most important structural material, even to this day. Numerous design concepts have been developed to create and/or tailor new steels suited to the most varied applications. High-manganese steels (HMnS) stand out for their excellent mechanical properties and their capacity to make use of a variety of physical mechanisms to tailor their microstructure, and thus their properties. With this in mind, in this contribution, we explore the possibility of extending the alloy design concepts that haven been used successfully in HMnS to the recently introduced high-entropy alloys (HEA). To this aim, one HMnS steel and the classical HEA Cantor alloy were subjected to cold rolling and heat treatment. The evolution of the microstructure and texture during the processing of the alloys and the resulting properties were characterized and studied. Based on these results, the physical mechanisms active in the investigated HMnS and HEA were identified and discussed. The results evidenced a substantial transferability of the design concepts and more importantly, they hint at a larger potential for microstructure and property tailoring in the HEA.

# Performance and photocatalytic activity of $V_2O_5/TiO_2$ nanocomposites for the photodegradation of Rhodamine B

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**Abstract**

In the present work, the $V_2O_5/TiO_2$ nanocomposites with different loadings of $V_2O_5$ (5, 10 and 15 wt.%) have been synthesized by the wet chemical method. The influence of $V^{5+}$ loadings was examined on the photocatalytic activities of the wet chemical derived $V_2O_5/TiO_2$ nanocomposites using a structure-directing template. The impact of $V^{5+}$ concentrations utilized to prepared the composites have been found to resourcefully on the specific surface area, pore volume and photocatalytic activity. The prepared nanocomposites were investigated by various techniques like XRD, FE-SEM, HR-TEM, UV, PL and FTIR. The structural analysis revealed that $V_2O_5/TiO_2$ has signals of anatase and rutile phases of $TiO_2$. The FT-IR results show that more hydroxyl groups binding onto the surface of the sample 15 wt.% $V_2O_5/TiO_2$ which enhances the photodegradation as they yield $OH^*$. Hence, the improved photodegradation of dyes with photocatalyst nanocomposites under visible irradiation can be comprehended and their kinetic model has been established to pronounce effectively the photodegradation of RhB.

# Effect on annealing induced on $BiVO_4$ nanoparticles synthesized by the hydrothermal method

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**Abstract**

We have studied the influence of annealing induced on the structural, optical and electrical properties of $BiVO_4$ nanoparticles were synthesized by the hydrothermal method. The impact of annealing in temperature range of 200, 300, 400, 500$^oC$ on the properties of $BiVO_4$ nanoparticles have been investigated by various techniques. The X-ray diffraction analysis revealed that all $BiVO_4$ nanoparticles have (002) preferred orientation. The Full-width at half-maximum (FWHM) of XRD from the (200) crystal plane was observed to reach to a minimum value of 0.134° from $BiVO_4$ sample, annealed at 400°C. The crystalline property and grain size of the studied samples were found to increase after annealing. The Evaluation of optical band gap ($E_g$) value agrees approximately with that of bulk $BiVO_4$. It is observed that band gap decreases as the annealing temperature is increased from 200°C to 400°C. The XPS analysis revealed the presence of oxygen interstitials and vacancies point defects in $BiVO_4$ nanoparticles annealed at 400°C.

# Influence of Co doped $BiVO_4$ nanoparticles for photocatalytic activity

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**Abstract**

In this study, the pure and cobalt doped $BiVO_4$ nanoparticles were synthesized by the wet chemical method using the $Bi(NO_3)_3.5H_2O$ and $NH_4VO_3$ as the source materials. The HRTEM image of the Co-doped $BiVO_4$ nanoparticles revealed a clear lattice spacing of 0.52 nm corresponding to the interplanar spacing of wurtzite $BiVO_4$ (002) plane. The structural analysis revealed that the prepared samples confirm the formation of single phase monoclinic crystalline structure and without any secondary phases is detected. The optical band gap ($E_g$) was calculated using the diffuse reflectance and it is found depend on cobalt substitution ions. The M-H loops exhibits ferromagnetic behaviour for the substitution of Cobalt doped $BiVO_4$ at room temperature and diamagnetic behaviour for $BiVO_4$. In addition, the incorporation of samples exhibit much higher photocatalytic activity for malachite green degradation under visible light irradiation than undoped $BiVO_4$.

# Impact of structural, optical and electrical properties of Ni doped $BiVO_4$ nanoparticles and its visible light induced photocatalytic activity

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**Abstract**

The pure and Ni substituted $BiVO_4$ nanoparticles (Ni is 3, 5 and 7 mol%) were prepared by the wet chemical precipitation method and characterized by various techniques like XRD, SEM-EDS, HRTEM, PL, XPS and DC conductivity studies. The X-ray diffraction spectra of Ni doped $BiVO_4$ samples display the shifting of intense XRD peak toward the higher angle which revealed that dopant Ni is successfully incorporated into the lattice structure of $BiVO_4$ nanoparticles. The photoluminescence and Raman spectra analysis specified that the presence of oxygen vacancies and donor defects in the incorporated samples. As an approach, the photocatalytic activities of the studied samples were examined by the degradation of model dyes Methylene Blue, Methyl Orange and a mixture of Methylene Blue and Methyl Orange solutions under visible-light irradiation (>300 nm). As a result, we are obviously confirmation that Ni:$BiVO_4$ nanoparticles with in a 0.8:0.9 mole ratio exhibited the highest photocatalytic activity in dye wastewater treatment.

# Role of surfactant on $WO_3$ nanostructures by hydrothermal method for gas sensors

**S. Thangabalu[1], T. Usha Devi[1], N. Senthil Kumar[1]***

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**Abstract**

We report the synthesis of WO3 nanostructures using the various surfactants by hydrothermal method. In this study demonstrate and approach the synthesis method growth of various morphologies of WO3 like (i) flower like nanorods and nanoflakes, (ii) self-assembled hierarchical structures and (iii) nanosheets. The prepared samples were characterized through various techniques XRD, SEM-EDS, HR-TEM, PL, XPS and DC conductivity studies. The structural analysis revealed that the lattice constants have been changed to some extents. The resulting various nanostructures are highly crystalline and largely monodisperse WO3 nanoparticles. When used as a sensing material in gas sensor, it exhibits the high-performance gas sensing performances including high gas response, good selectivity, fast response/recovery time which is good repeatability. Our results will help in the growing face selective WO3 for many functional applications.

# Synthesis, Optical and Thermal Characterization of $BaCl_2$ doped L-Tyrosine Single Crystals

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## Abstract

The single crystals of Barium Chloride doped L-Tyrosine have been successfully grown by slow evaporation technique at room temperature. The grown crystals have been subjected to Single crystal XRD, UV-Visible spectroscopy, FTIR, and Thermal analysis. Single crystal XRD reveals that both grown single crystals belong to the monoclinic system. The optical cut-off wavelength and the transparency of the single crystal were estimated by UV-Vis transmittance spectrum. The FTIR spectroscopy confirms the presence of all the functional groups. The thermal properties of crystals were evaluated by TGA and DTA techniques and the crystal was found to be stable up to 250°C.

# Preparation and Characterization of $MoO_3$ thin film by spray pyrolysis method for gas sensing application

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**Abstract**

The $MoO_3$ thin films were deposited by spray pyrolysis method onto glass substrates. The effects of annealing in temperature range of 250, 350 to 450 °C on the structural and optical properties of the $MoO_3$ films have been studied. This work represents the gas sensing features acquired by spray pyrolysis method at various deposition and annealing temperatures. Substrate temperature and oxygen pressure are the key parameters which influences the deposition are applied during the process. The structural analysis revealed that the deposited films are textured along the (h k l) directions. The crystallinity was strongly influenced by temperature of substrate and oxygen pressure. The optical band gap of $MoO_3$ films initially blue shifted (3.4–3.37 eV) when annealed at 450 °C and further red shifted in the range of 3.23 to 3.1 eV being annealed at 250 to 450 °C range. Hence, all these results point out that post annealing get better the films quality with condensed roughness and better crystalline properties. Moreover, the sensor response of all investigated samples increased with enhancing temperature.

# Effect of substrate temperature on the properties of Molybdenum (VI) oxide thin films prepared by Nebulizer spray pyrolysis (NSP) technique

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**Abstract**

In this study, Molybdenum (VI) oxide ($MoO_3$) thin films were prepared at different substrate temperatures 200°C, 300°C and 400°C by the Nebulizer spray pyrolysis technique. The structural studies confirmed that the formation of $MoO_3$ in cubic phase. The surface morphology analysis revealed that the sett stone structure when annealed at 400oC. It is observed that the molybdenum (VI) oxide thin films shows better particle growth at higher substrate temperature, which is good agreement with the XRD results. The optical transmittance spectrum of molybdenum (VI) oxide thin film was carried out from 300 nm and 700 nm. The PL spectra of studied $MoO_3$ thin films exhibits sharp and broad peaks at 310 and 466 nm correspond to blue emission in the visible region. The obtained results were discussed the feasibility of prepared thin films for the fabrication of photoconducting application.

# Influence of substrate temperature on the properties of Bismuth vanadate ($BiVO_4$) thin films prepared by Nebulizer spray pyrolysis (NSP) technique

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**Abstract**

In this study, pure Bismuth vanadate ($BiVO_4$) thin films were prepared at different substrate temperatures 200°C, 300°C, and 400°C by nebulizer spray pyrolysis technique. Structural studies confirm formation of $BiVO_4$ in hexagonal phase. The rock bridge structure is obtained from SEM image. It is observed that the bismuth vanadate thin films shows better particle growth at lower substrate temperature, which is good agreement with the XRD results. Also, the structural analysis show that the increasing the annealing temperature resulted in larger crystallite size and higher crystallinity with increased surface roughness. The optical transmittance spectrum of bismuth vanadate thin film was carried out from 300 nm and 700 nm. The PL spectra of $BiVO_4$ thin films exhibits sharp and broad peaks at 220 and 346 nm correspond to blue emission in the visible region.

# Structural, morphological and magnetic properties of Algae/Co-Fe-O and Algae/Ag-Fe-O nanocomposites

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## Abstract

Algae assisted auto combustion method was adopted to prepare Algae/Ag-Fe-O and Algae/Co-Fe-O nanoparticles. XRD, FTIR, FE-SEM, EDX and VSM characterization techniques are used to analyse structural and magnetic properties of present nano composite systems. EDX spectra revealed the presence of expected stoichiometry in Algae/Co-Fe-O system but not in Algae/Ag-Fe-O. XRD patterns indicate the cubic phases of nanoparticles encapsulated in the algae matrix. The sizes of the particles are found to be in the range of 15-20 nm. The magnetic behaviour of composites depending on the nature of dopant where Algae/Co-Fe-O nanoparticles is exhibiting ferromagnetic nature and Algae/Ag-Fe-O nanoparticles is exhibiting super paramagnetic nature.

# Research Paradigm Shift in Smart electro-magneto rheological fluids for biomedical applications :: A Contemporary Survey

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**Abstract**

Smart fluids like Electro-rheological (ER) Fluid and Magneto-rheological (MR) fluid inherent the properties of changing its color, shape or size in response to changes in the environment. This research paper projects the importance of the smart materials in medical applications, mainly focusing on the fast-moving robots used for minimally invasive surgeries (MIS). The MR and ER fluids play a vital role in design and development of sophisticated biomedical equipment's for dental implants, rehabilitation systems, braille reading devices and prosthetic devices. For any biomedical device to change the range of the haptic sensations the MR and ER fluids play a major role. By controlling the flow of the fluids through applied electric fields the haptic sensations in the device could be controlled in the fast-moving robots performing medical surgery. To view the deformation of the fluid these haptic sensations could produce various stimulus information to a user such as tactile sensations and kinesthetic force. The biomedical equipment's surveyed in this article includes the fast-moving robots used for surgeries, and soft robotics used for MIS. We seek to provide the roadmap for manufacturing smart robots that have a safe interaction with fragile objects adapting to the mechanical and chemical perturbations using inexpensive materials and manufacturing methods.

# A review on Sensors, Biosensors and Chemical Sensors

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**Abstract**

Sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics. In biomedicine and biotechnology, sensors which detect analytes thanks to a biological component, such as cells, protein, nucleic acid or biomimetic polymers, are called biosensors. Whereas a non-biological sensor, even organic (carbon chemistry), for biological analytes is referred to as sensor or nanosensor. This terminology applies for both in-vitro and in vivo applications. The encapsulation of the biological component in biosensors, presents a slightly different problem that ordinary sensors; this can either be done by means of a semipermeable barrier, such as a dialysis membrane or a hydrogel, or a 3D polymer matrix, which either physically constrains the sensing macromolecule or chemically constrains the macromolecule by bounding it to the scaffold. A chemical sensor is a self-contained analytical device that can provide information about the chemical composition of its environment, that is, a liquid or a gas phase. The information is provided in the form of a measurable physical signal that is correlated with the concentration of a certain chemical species (termed as analyte). Two main steps are involved in the functioning of a chemical sensor, namely, recognition and transduction. In the recognition step, analyte molecules interact selectively with receptor molecules or sites included in the structure of the recognition element of the sensor. Consequently, a characteristic physical parameter varies and this variation is reported by means of an integrated transducer that generates the output signal. A chemical sensor based on recognition material of biological nature is a biosensor. However, as synthetic biomimetic materials are going to substitute to some extent recognition biomaterials, a sharp distinction between a biosensor and a standard chemical sensor is superfluous. Typical biomimetic materials used in sensor development are molecularly imprinted polymers and aptamers.

# Doped and undoped ZnO nanostructures for sodium-ion batteries

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**Abstract:**

Development of sodium-ion battery electrode materials currently lags behind electrodes in commercial lithium-ion batteries. We require careful identification of the underlying sodiation mechanism in sodium-ion battery. ZnO nanostructures are found to undergo step-by-step electrochemical displacement reaction, upon electrochemical sodiation. Hence, towards a goal of optimizing the microstructure of electrode materials in order to develop high performance sodium-ion batteries ZnO nanostructures were prepared by spin coating technique. The structural and morphological properties of undoped and rare earth (La) doped ZnO was studied using X-ray diffraction (XRD), and Scanning Electron Microscopy (SEM). ZnO samples with different mole concentration 0.2, 0.4 and 0.8 M at 2500 rpm were prepared. The high crystalline nature of the prepared 0.8 M sample was confirmed by XRD technique. The sample with 0.8 M was prepared for different spinning rates at 2000, 2500 and 3000 rpm; high intensity was observed for 0.8 M at 3000 rpm. The diffraction peak (002) in La-doped films slightly shift towards lower angles suggesting that the rare earth ions have been incorporated in the $Zn^{2+}$ sites of the ZnO lattice. The porous nature of the ZnO and La-ZnO were observed by SEM, indicting the prepared samples are feasible to be used as an electrode material.

# Investigation of structural, morphological and magnetic properties of Ni-Mg ferrite nanoparticles for biomedical applications

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## Abstract

Ni substituted MgFe2O4 nanoparticles (NPs) were synthesized by a novel honey assisted combustion method. The effects of annealing treatment on the formation of phases, structure, morphology, particle size and magnetic properties of the synthesized powders were studied by XRD, SEM, EDX, TEM and magnetic measurements. The crystallite size of the synthesized and annealed powders was between 12 nm to 38 nm. The magnetic parameters like saturation magnetization and coercivity of the powders are influenced by the annealing; thus the annealing leads to a decrease of coersivity and to an increase of saturation magnetization. The highest value of saturation magnetization (48.49emu/g) was obtained by the $MgFe_2O_4$ nanoparticles with the coercivity value 858.1 G. The changes in magnetic properties of Ni substituted Mg ferrite can be ascribed to the change of particle sizes, which is depends upon annealing temperature. The biomedical activities of the samples have been analyzed and the obtained results are discussed.

# Evaluation of structural and magnetic properties of Zn doped Mg ferrite nanoparticles for gas sensor applications

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## Abstract

Zn doped $MgFe_2O_4$ were synthesized by auto combustion technique and followed by different annealing temperature 600 $^oC$ and 900 $^oC$. Reported structural results revealed the cubic spinel structure of the ferrite phase belonging to *fd3m* space group. The increase in saturation magnetization with increase of annealing temperature is expected due to the increase in particle size. Higher saturation magnetization of 61.32 emu/g was reported for the sample annealed at 900 $^oC$ . The increase in the blocking temperature (magnetic ordering) is due to the increase in magnetocrystalline anisotropy rather than an increase in particle sizes. The Zn-Mg ferrite nanoparticles are showing good sensor response for both LPG and acetone.

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