MANIPAL UNIVERSITY
JAIPUR

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RESEARCH CHRONICLES
2023

Department of Physics

HoD Message

As the Head of the Department of Physics, Manipal University Jaipur (MUJ), it gives me immense pleasure to extend my warmest greetings to everyone. This Research Chronicle is a testament to the collective achievements of our department. Over the years, the department of Physics has proved excellence in research, teaching, and innovation. Our students have continually impressed with their intellectual curiosity and dedication, our faculty have made significant contributions to their fields, and our alumni have gone on to make remarkable impacts in academia, industry, and beyond.

The department has put consistent efforts into attracting the best researchers through various events organized at MUJ. The department focuses not just on academics but also works towards raising the research standards of the UG/PG students along with the PhD graduates. The UG/PG research outcome has witnessed an exponential growth over the years in terms of research publications.

By utilizing the unique advantage of the eco-system of the inter- and multi-disciplinary knowledge culture of the Manipal University Jaipur, the department has initiated many new research collaborations within the university as well as outside. We, at Physics Department, are consistently leapfrogging traditional boundaries in physics and venturing into newer domains aligned with the vision of Govt. of India and Quantum Science and Technology is one such initiative.

I would like to extend my heartfelt gratitude to everyone who has been a part of this journey. Your hard work, enthusiasm, and commitment have been the pillars of our success. As we look forward, let us continue to strive for excellence and push the boundaries of what is possible. My sincere gratitude goes to all the government and industrial funding agencies for supporting our research activities. My heartfelt gratitude to the leadership of MUJ for their constant and unwavering support. I thank Dr Manoj Kumar Saini for bringing out this Research Chronicle in a timely manner and hope that the readers find this report informative and useful.

Dr. Ashima Bagaria
Professor & Head
Department Manipal University Jaipur

OVERVIEW

The Department of Physics at Manipal University Jaipur comes under the umbrella of the School of Basic Sciences. The department was established after the inception of the university in 2011 with a vision to provide excellence in higher education in physics and to pursue research in state-of-the-art areas of pure, applied, and interdisciplinary science. In the department faculty members are highly qualified and hail from the globally recognized best institutions with rich experience in teaching and have made significant contributions to their respective areas of research. The department also hosts several research projects sponsored by SERB, DST, UGC, DAE, and DST Rajasthan.

Department of Physics offers undergraduate course, B.Sc. (Hons) Physics, postgraduate course, M.Sc. Physics and Ph.D. program. The UG/PG theory courses are designed as per the UGC Model curricula for Physics which will help the students to qualify NET/JRF/GATE/JEST competitive examination required for availing scholarships and other career opportunities. The department is equipped with state-of-art UG and PG labs, and a well-equipped laboratory to cater the first-year students of all engineering programs workshops, symposium, and training sessions are arranged to enable students to learn and interact with scientists and researchers from all around the country on different specialised topics in physics.

National & International Collaborations

Institute/University

- Inter University Accelerator Centre, New Delhi, India
- UGC-DAE Consortium for Scientific Research, Indore
- Indian Institute of Technology, Bombay
- University of Petroleum and Energy Studies, Dehradun, India
- Department of Physics, University of Allahabad, Prayagraj, India
- Department of Physics, Institute of Science, Banaras Hindu University, Varanasi, India
- Indian Institute of Technology Roorkee, Uttarakhand, India
- National Institute of Technology, Warangal, Telangana State, India
- Bhabha Atomic Research Center, Trombay, Mumbai, India
- Indian Institute of Science, Bengaluru
- Indian Institute of Engineering Science and Technology, Shibpur
- Tata Institute of Fundamental Research, India
- Michigan State University, USA
- Manipal Institute of Technology, Manipal
- National Physical Laboratory, Delhi
- Manipal Centre for Natural Sciences, MAHE, Manipal
- Department of Atomic and Molecular Physics (DAMP), MAHE, Manipal
- Calcutta University, NPDF, Kolkata
- Amity University, Noida
- National Physical Laboratory, Delhi
- Indian Institute of Technology Jodhpur, Rajasthan
- The University of Texas at El Paso, USA
- Indian Institute of Technology Hyderabad, India
- IPS academy, Indore
- Amity University Jaipur
- Bharathiar University- Nanoscience & Technology Department, Coimbatore, India
- Department of Physics, University of Rajasthan, Jaipur
- Government Women Engineering college, Ajmer
- S. S. Jain Subodh PG College, Jaipur
- Flinders University Adelaide, Australia
- National University of Science and Technology, Moscow, Russia
- Theoretical Physics and Quantum Technologies Department, NUST 'MISIS', Moscow, Russia
- National University of Science and Technology, Moscow, Russia
- Tsung Dao Lee Institute, Shanghai, China
- Centre for Research in Nanoscience and Nanotechnology, Salt Lake Campus, University of Calcutta, India
- Department of Physics, NIT Durgapur, India
- Institute of Nano Science and Technology (INST) Mohali
- Isotope and Radiation Application Division (IRAD), Bhabha Atomic Research Centre, Mumbai

- National Institute of Technology Meghalaya, India
- Department of Physics, NIT Meghalaya, India
- Saha Institute of Nuclear Physics, Kolkata, India
- Indian Institute of Technology, Ropar
- Department of Physics, NIT Durgapur
- Department of Physics, Northeastern Regional Institute of Science and Technology, Itanagar, India

Memorandum of Understanding (MoU's)

- M. Nalbandyan State University of Shirak, Paruyr Sevak 4, Gyumri 3126, Armenia
- RI Instruments and Innovation India and Group Company RINZTECH, New Zealand.
- Bharathiar University- Nanoscience & Technology Department, Coimbatore, India.

Group Photo of the Department

Research Scholars

Ms. Richa Sharma
Reg. No.: 171019601
Thesis Tittle: Detection of Cancer Biomarkers using MoS2 Based Electrochemical Sensor.

Ms. Kanchan Soni
Reg. No.: 181019607
Thesis Tittle: Investigation of Heavy Metal Resistance and Metabolite Bacterial Isolates Native to Marine Environment.

Ms. Ashima Sharma
Reg. No.: 202505054
Thesis Tittle: 2D Material Based Nanotheraputics Platform for PDT/PTT and Chemotherapy of Breast Cancer Cells.

Ms. Khushabu Shekhawat
Reg. No.: 23FS30SBS00017
Thesis Tittle: IMXene -Based Chemiresistive Sensor for Sensitive and Selective Detection of H2S Gas.

Mr. Umesh Kumar Singh
Reg. No.: 170705601
Thesis Tittle: Description of Superheavy Nuclei Using RMF Theory.

Mr. Akshay Jain
Reg. No.: 202505053
Thesis Tittle: Theoretical Investigation of Decay Properties of Nuclei.

Ms. Karishma Jain
Reg. No.: 221051026
Thesis Tittle: Investigation of Electronic, Optical, and Thermoelectric Properties of Novel Perovskite Materials.

Mr. Ashish Kumar
Reg. No.: 23FS30SBS00079
Thesis Tittle: To Study Photodecomposition Behavior of Organic Dyes on Sn and Bi Based Oxide Nanoparticles

Research Scholars

Ms. Deepika Maan
Reg. No.: 23FS30SBS00048
Thesis Tittle: Adsorption of Dyes from Wastewater by Metal-Organic Framework.

Ms. Shachi Pachauri
Reg. No.: 181019603
Thesis Tittle: Study of Various Instabilities and Propagating Waves in Inhomogeneous Magnetized Plasmas Under the Effect of Recombination.

Mr. Shiva Shakti Singh
Reg. No.: 181019604
Thesis Tittle: Study of Instabilities in Magnetized Quantum Plasmas Considering Fermi Dirac Distribution Along with Statistical Pressure.

Mr. Mahesh Malpani
Reg. No.: 23FS30SBS00063
Thesis Tittle: --Yet to Be Decided--

Mr. Ashish Kumar Kumawat
Reg. No.: 191024609
Thesis Tittle: Study of Metal-Modified Vanadium Oxide for Functional Applications.

Mr. Sanjay Kumar
Reg. No.: 202505049
Thesis Tittle: Exploring the Ground State of Geometrically Frustrated Magnetic System.

Mr. Prarbdh Bhatt
Reg. No.: 202505052
Thesis Tittle: Synthesis and Characterization of Transition Metal Doped WS2 Nanostructures.

Mr. Akash
Reg. No.: 202505050
Thesis Tittle: Functional Nano Ceramic Hydroxides for Advanced Application.

Research Scholars

Ms. Jyoti Kumari
Reg. No.: 211051018
Thesis Tittle: Synthesis and Characterization of Nano Ceramic Thin Film.

Mr. Lalit
Reg. No.: 211051027
Thesis Tittle: Integrated Approaches for Environmental Remediation Metal Enhanced Zeolites Biochar's and Tio2 for Sustainable Catalysts and Water Remediation.

Ms. Neelam Nagda
Reg. No.: 23FS30SBS00023
Thesis Tittle: Non–Noble Metal Based Catalysts for Sustainable Energy Production.

Mr. Surendra Singh
Reg. No.: 23FS30SBS00076
Thesis Tittle: Ceramic Based Nanocomposites Material for Wastewater Treatment.

Ms. Arpana Pal Sharma
Reg. No.: 202505055
Thesis Tittle: Nano Generator Using Polymer Nanocomposite.

Mr. Tara Chand Badiwal
Reg. No.: 211051006
Thesis Tittle: Characterization of Semiconductor Nanostructures Fabricated by GLAD Technique.

Mr. Hansraj Karwasara
Reg. No.: 202505048
Thesis Tittle: Investigation of Electronic, Optical, and Thermoelectric Properties of Novel Perovskite Materials.

Ms. Shikha Sharma
Reg. No.: 191024612
Thesis Tittle: Electronic and Optical Properties of Some Technologically Important Materials.

Research Scholars

Ms. Karishma Sharma
Reg. No.: 23FS30SBS00016
Thesis Tittle: Investigation of Electronic & Optical properties of Energy Conversion Materials for Solar Photovoltaic Applications.

Ms. Kritika Garg
Reg. No.: 23FS30SBS00020
Thesis Tittle: Temperature Dependent Vibrational Spectroscopic Studies of Pure and Mixed Liquid Crystal.

Mr. Chandan
Reg. No.: 170705604
Thesis Tittle: Metal Oxide Based Electrochemical Biosensor Employing Enzyme Immobilization on Soy Protein Matrix.

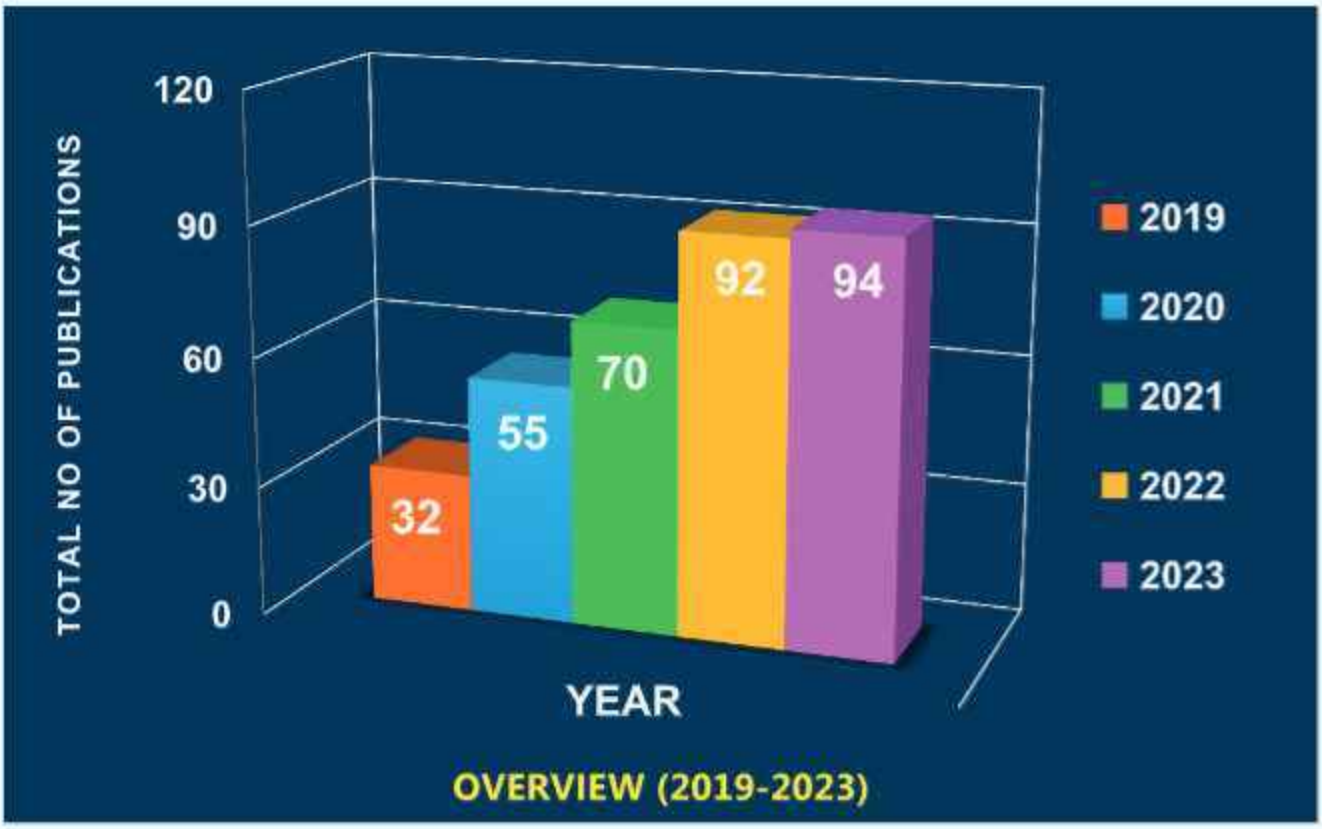
Non-Teaching Staff

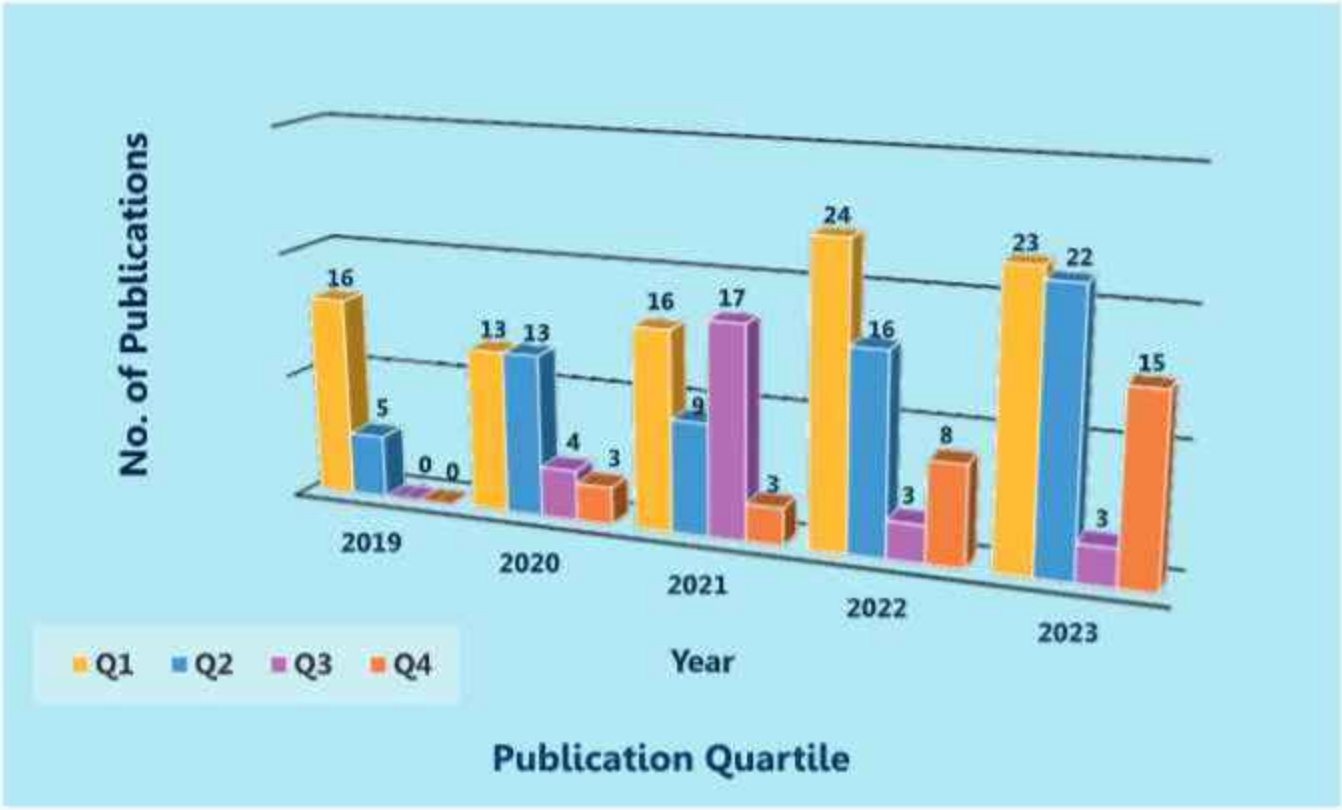
Mr. Virendra Singh Shekhawat
Lab Technician

Mr. Harish Kumar Ojha
Lab Technician

Mr. Harish Medatwal
Junior General Duty Worker Lab

Research Summary





Achievements: 2023

Mr. Ashish Somvanshi (MSc)
Best Paper Award
Conference: International Conference on Recent Advances in Fluid Mechanics and Nanoelectronics

Ms. Tulip (BSc (Hons) Physics)
Score Ist Position
Event: News Mania, Poddar International College.

Dr. Saikat Chattopadhyay (Faculty)
Young Reseracher Award
Conference: International Conference on Recent Advances in Fluid Mechanics and Nanoelectronics.

Dr. Anupam Sharma (Faculty)
Best Oral Presentation Award
Conference: 6th International Conference on Nanomaterials for Energy and Environment Nano E2.

Achievements: 2023

Mr. Bharat Sonkiya (BSc (Hons) Physics)
Selected for Higher Studies at
Université Paris-Saclay, Paris

université PARIS-SACLAY

UNIVERSITÉ DE GENÈVE

Mr. Ashwin Bhartia (BSc (Hons) Physics)
Selected for Higher Studies at
University of Geneve, Switzerland

Mr. Jay Jagdish Jain (BSc (Hons) Physics)
Selected for Higher Studies at
University of Bologna, Italy

Faculty Members

Dr. Ashima Bagaria
Professor & Head of the Department
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Profile Link: Orcid: 0000-0003-0666-1945, Scopus Id: 15755457600
Google Scholar: LLcNT6kAAAAJ&hl Department of Physics | Faculty of Science (FOS) At Manipal University Jaipur, MUJ

Research Interest & Personal Statement: I am currently working as Professor and Head, at the department of Physics, Manipal University Jaipur. My I obtained my PhD from the Department of Physics, Indian Institute of Science Bangalore in 2007. Post PhD I received the NIH fellowship USA and moved to Yale School of Medicine, Yale University, Connecticut USA. After a stint at Yale, I moved to Brookhaven National Laboratory NY, USA upon receiving the NSF fellowship USA. In 2011 I received the ANR fellowship from the French Govt. and moved to Institute Pasteur, Paris, France. I am the recipient of the Women Scientist Award from the Department of Science and Technology, Govt of Rajasthan, Young Investigator award from the Department of Biotechnology, Govt. of India. While working with various institutions globally, I have published book chapters and research papers/articles in journals of international repute. My work on structural biophysics has found place in "NATURE Structure Biology" publishing as "Molecule of the Month" and have presented more than 40 research papers in various conferences in India & abroad.

I have always been captivated by the intricate ways in which materials interact with their environment. This fascination has driven my career as a scientist specializing in biomaterials and multifunctional materials. My journey began with a desire to understand the fundamental structure and properties of materials and subsequently working towards harnessing these properties for transformative applications in healthcare, energy, & technology. My research focuses on developing innovative biomaterials for regenerative medicine, drug delivery systems, and medical implants. By integrating principles of chemistry, biology, and engineering, I aim to create materials that not only mimic natural biological functions but also enhance them, paving the way for advanced therapeutic solutions.

In parallel, my work on multifunctional materials, specially 2-D materials, explores the design and synthesis of materials that exhibit multiple, synergistic properties. These materials can respond to environmental stimuli, conduct electricity, or change shape, opening new horizons in fields such as smart textiles, sensors, and energy storage devices.

Dr. Sushil Kumar Jain
Professor,
Director of Directorate of Alumni Relations (DoAR) &
Chairperson of Manipal University Alumni Association (MUJAA)
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Orcid: https://orcid.org/0000-0001-6454-2392, https://muj.irins.org/profile/212671
Google Scholar: https://scholar.google.com/citations?user=UG6sI8YAAAAJ&hl=hi&oi=sra

Research Interest & Personal Statement:

As a passionate researcher, my interest in nanotechnology & computational nuclear research fields stems from its boundless potential to revolutionize various aspects of our lives. The intricate manipulation of matter at the nanoscale offers unprecedented opportunities to address pressing challenges in fields ranging from healthcare and energy to environmental sustainability. Furthermore, I am intrigued by the intersection of nanotechnology and sustainable energy, where nanomaterials play a pivotal role in improving the efficiency and durability of renewable energy technologies. By delving into the development of next-generation solar cells, energy storage devices, and photocatalysts, I aim to contribute to the transition towards a greener and more sustainable future. Also, I am interested in computational nuclear research.

Dr. Pushpendra Kumar
Associate professor
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Department of Physics | Faculty of Science(FOS) At Manipal University Jaipur, MUJ

Research Interest & Personal Statement: Ceramic based nanocomposite materials for wastewater treatment, energy storage, fuel cell applications, Synthesis and characterization of graphene for supercapacitor applications, Porous Silicon, Thin films and metal nanoparticles One of the best thing one can do is adding a small new scientific knowledge to the existing one.

Dr. Nilanjan Halder
Associate Professor &
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Profile Link: https://scholar.google.co.in/citations?user=45x-9uAAAAAJ&hl=en

Research Interest & Personal Statement: With a diverse academic and professional background spanning various prestigious institutions globally, my research interests primarily lie in the field of semiconductor materials and nanotechnology, focusing on their applications in photovoltaic, photocatalytic, optoelectronic, and nano electronic devices.

Currently serving as an Associate Professor at Manipal University Jaipur, my research endeavors revolve around the exploration of Metal Semiconductor Oxide materials such as TiO2, ZnO, Ga2O3, V2O5, CuO, etc. as well as functional nanomaterials like WS2. I am particularly intrigued by their nanostructures and their potential applications in areas such as photocatalysis, and devices like solar-blind photodetectors, memristors, etc. Additionally, I have established a specialized Glancing Angle Deposition setup for the growth of one-dimensional nanostructures, augmenting our capability to engineer novel materials for advanced applications.

My involvement in setting up the Sophisticated Analytical Instrument Facility (SAIF) at Manipal University Jaipur underscores my commitment to facilitating cutting-edge research infrastructure. From procurement to installation, I have been instrumental in ensuring access to state-of-the-art instruments such as XRD setups, FESEM, and Confocal Raman spectrometers, crucial for comprehensive materials characterization.

During my tenure as a Post-doctoral Fellow at K. U. Leuven, Belgium, I spearheaded the development of ultrahigh vacuum (UHV) magnetron sputtering systems, focusing on embedding nanoclusters into diverse matrices for practical integration into nanodevices. Furthermore, my experiences as an Institute Post Doctoral Fellow at IIT-Bombay and as a Visiting Research Scholar at the University of Nevada Las Vegas have enriched my understanding of nanofabrication techniques and materials characterization methodologies. A large part of my Doctoral research was related to the optimization of the semiconductor layer properties and heterojunction characteristics through suitable modification of the growth technique. Thus, from epitaxial growth and lithographic fabrication to in-depth characterization utilizing a myriad of techniques including Hall measurements, electrical characterization, and photoluminescence spectroscopy, I have gained a comprehensive skill set essential for advancing semiconductor research.

Moving forward, I am committed to pushing the frontiers of semiconductor nanomaterials research, dedicated to addressing societal challenges through pioneering technological solutions. My interdisciplinary approach and relentless pursuit of excellence position me to make substantial contributions to academia and industry in advanced semiconductor materials and nanotechnology.

Dr. Anupam Sharma
Associate professor
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Research Interest & Personal Statement: During my PhD, I worked on Photoelectron Spectroscopy beam line installed on Indus-1 (450 MeV Synchrotron radiation Source), Raja Ramanna Center for Advance Technology (RRCAT), Indore. During this period, I had been trying to understand Synchrotron radiation and its utilization and gathered experience in operating the beamline and data acquisition for carrying out the photoelectron spectroscopy (PES) experiments.

During my postdoctoral work, I was involved in the fabrication of magnetic nanomaterials to understand the basic magnetism in these structures. The aim of my research was to study the growth and magnetic properties of magnetic nanostructures on templated as well as on plane substrates by normal angle deposition techniques focusing mainly on the magnetization reversal process in these structures. In this way, one can control the aspect ratio (magnetic shape anisotropy) of various magnetic nanostructures that can be grown on these templates.

In addition to this, I have been involved in a project related to the synthesis of Ni/Ru multilayers and to study their structural and magnetic properties as a function of film thickness.

Currently, I am working on synthesis of Cu2O thin films using glancing angle deposition technique and to study their optical and structural properties such as optical anisotropy, porosity, and electronic structure etc. as a function of deposition angle and annealing temperatures.

Dr. Kamakhya Prakash Misra
Assistant Professor
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Google Scholar: https://scholar.google.co.in/citations?user=D 5X yYEAAAAJ&hl=en
Research Gate: https://www.researchgate.net/profile/Kama khya-Prakash-Misra

Research Interest & Personal Statement: My research work is focused on band gap engineering of wide band-gap semiconductors like ZnO and TiO2 using various dopants and controlling the processing parameters. I use mainly sol-gel synthesis technique for preparing thin films or nanoparticles. Major characterizations that I have been using for understanding various aspects of materials/thin films developed in our lab, are XRD, UV-Vis, photo-luminescence, FE-SEM and AFM. My recent work is also aligned to biomaterials and bioimaging.

Dr. Saikat Chattopadhyay
Assistant Professor
Email: saikat.chattopadhyay@jaipur.manipal.edu

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Research Interest & Personal Statement: As an Assistant Professor of Physics, I am engaged in teaching engineering physics, mathematical physics, classical mechanics, and quantum mechanics for graduate and post-graduate students. I am mentoring a research team of highly motivated PhD and graduate student members. We are actively involved in investigating structural, optical, and magnetic properties in a wide variety of II-VI nano-semiconductors. Our major research interests extend from fundamental understanding of quantum mechanical effects on charge and spin states in a nano-scale systems to their possible scientific applications. We are interested to explore carbon-based 2-D systems like graphene for futuristic opto-electronics and sensor applications. Apart from my academic and research commitment I am actively involved in university examination management system and other administrative work.

Dr. Rashi Nathawat
Assistant Professor
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Google Scholar: https://scholar.google.co.in/citations?user=Yp_R95gAAAAJ&hl =en
Research Gate: https://www.researchgate.net/profile/RashiNathawat/unconfirmed?acceptedAuthorUid=2269500545

Research Interest & Personal Statement: The current focus of my research is on multiferroic materials for energy applications include investigating the unique coupling of magnetic, dielectric and electric properties in this material to develop more efficient energy conversion and storage devices. The potential research direction for future research includes designing novel multiferroic composite material for next generation solar cells, batteries and energy harvesting devices.

On the other hand, my research group has interest in metal-organic frameworks (MOFs) for sensing and wastewater treatment involve exploring the high surface area, tunable pore structure, and functionalization of MOFs for applications in various analytes, such as gases, pollutants, ot biomarker. My research group is interested in utilizing MOFs for adsorption and catalytic decomposition of pollutants in wastewater treatment processes to improve efficiency and sustainability. This research area holds great promise for addressing key societal challenges related to energy sustainability, environmental pollution and resource conservation.

Dr. Manoj Kumar Saini
Assistant Professor
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Research Interest & Personal Statement: My academic journey and professional experiences have been profoundly shaped by a deep-seated passion for understanding the intricate molecular dynamics of glass-forming systems and the thermodynamics underlying glass formation in diverse materials. This multidisciplinary approach has allowed me to explore the fundamental relaxation processes and phase transitions that are critical to advancing material science and its applications. During my Ph.D. at Jawaharlal Nehru University, New Delhi, I delved into the study of relaxations and phase transitions in supercooled substances of pharmaceutical importance. This period was pivotal in honing my analytical and experimental skills, particularly in dielectric spectroscopy and calorimetric techniques. Postdoctoral experiences at prestigious institutions, such as at Yanshan University in China, University of Pisa, Italy and at University of Delhi, India, further enriched my expertise.

Securing the Science & Engineering Research Board Startup Research Grant (SERB-SRG) as a Principal Investigator was a significant milestone. In my academic career, I have been fortunate to receive several fellowships and awards, including the Dr. D. S. Kothari Postdoctoral fellowship and UGC-CSIR fellowships. These accolades have provided not just financial support but also a recognition of my research contributions. My research has been published in reputable journals, and I have presented my findings at numerous international conferences and workshops. These platforms have been instrumental in exchanging ideas with fellow researchers and staying abreast of the latest advancements in my field.

Dr. Shashi Shekher Tiwary
Assistant Professor
Email: shashi.tiwary@jaipur.manipal.edu

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Google Scholar: https://scholar.google. co.in/citations?user=CC -Kk04AAAAJ&hl=en
Research Gate: https://www.researchgate. net/profile/Shashi-Tiwary

Research Interest & Personal Statement: I have investigated very specific properties of rotational nuclei, including the evolution of the shell structure and exotic nuclear shapes in A = 120-140 mass region. The nuclei belonging to this mass region are showing transitional behavior, due to which various exotic modes of nuclear excitation, like magnetic rotation, anti-magnetic rotation, wobbling motion, tidal motion, chiral rotation, etc., and also provide evidence of several interesting structural phenomena, like back-bending, shape coexistence, signature splitting, etc., were reported in this mass region. I was focused to study the evolution of various shapes and phases as the function of β- and γ-deformations. To solve the purpose, I have chosen even-even tellurium isotopes near Z = 50 proton shell closure and 139Pm near N=82 neutron shell closure.

Dr. Abhik Mukherjee
Assistant Professor
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Profile Link: Mukherjee, Abhik - Author details - Scopus Preview

Research Interest & Personal Statement: I have completed my Ph.D. in Nonlinear Waves and Solitons, from Saha Institute of Nuclear Physics, Kolkata, India in 2016 under the guidance of Prof. Anjan Kundu and Prof. M.S. Janaki. In my PhD period, we have derived a completely integrable, nonlinear (2+1) dimensional integrable equation in modelling oceanic rogue wave dynamics. Later, the equation has been named as "Kundu Mukherjee Naskar (KMN)" equation by the scientists in this field and many important mathematical properties about the equation have been explored. The equation has gained importance in the field of nonlinear waves and solitons and more than 40 papers have been published on KMN equation till now.

Besing a mathematical physicist, I have worked in the mathematical modeling of Nonlinear waves and Solitons in various research fields such as Plasma Physics, Fluid Dynamics, Nonlinear & Quantum Optics, Superfluid hydrodynamics, Superconductivity etc. I have 5 year of postdoctoral experience in the Fundamental Quantum Science Division, Tsung-Dao Lee Institute, Shanghai, China (Project title: Cavity Quantum Electrodynamics of Twisted Bilayer Graphene); Physics and Applied Mathematics Unit, Indian Statistical Institute, Kolkata (visiting scientist); Department of Theoretical Physics and Quantum Technologies, National University of Science and Technology-MISIS, Moscow, Russia (Project title: Nonlinear phenomena in qubit ensembles interacting with electromagnetic field.) and in the Department of Mathematics and Applied mathematics, University of Cape Town, South Africa (Project title: Nonlinear Dynamics of Parity Time Symmetric systems) respectively.

I have received three research awards as:

1. IJRULA (International Journal for Research Under Literal Access) Research Leadership Award sponsored by World Research Council, Innovative Researcher in Nonlinear Dynamics in the year 2020,
2. ISSN (International Society for Scientific Network) Remarkable Researcher award of the year 2020 under, "ISSN GOLDEN RESEARCH PRIZE",
3. 2020 INSc (Institute of Scholars) Research Excellence Award.

Dr. Ashok Kumar Mondal
Assistant Professor
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Research Interest & Personal Statement: Using the indirect method (ANC Method), I am working on experimental nuclear astrophysics with a focus on studying the astrophysical reaction in stellar environment. Using the activation process, I will produce radioisotopes for use in medicine. Together with radiation physics, I'm focusing on theoretical computations to investigate various nuclear reactions utilising various reaction models.

Dr. Anurag
Assistant Professor
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Research Interest & Personal Statement: My current research interest is primarily in some theoretical aspects of nonlinear dynamical systems which is an exciting interdisciplinary research topic. I work on understanding the dynamics of systems which are Hamiltonian in nature. More specifically, we explore the regular and chaotic dynamics of Hamiltonian systems analytically and numerically. I am also working on understanding the dynamics if we make the system non-Hermitian by adding damping, forcing etc.. Apart from that, I am also interested in exploring the quantum dynamics of Hamiltonian systems which are often used to mimic the dynamics of molecules. In this regard, I have been trying to understand the classical-quantum correspondence of such systems.

Dr. Ashish Kumar
Assistant Professor
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Research Interest & Personal Statement: I specialize in examining how high-energy ionizing radiations, including electron beams, gamma rays, and alpha particles, influence the physicochemical properties of biopolymers, bio-fillers, and their blends and composites. My research delves into the molecular and structural modifications induced by these radiations, exploring their effects on material stability, mechanical strength, thermal behavior, and biodegradability. By understanding these interactions, my work aims to enhance the performance and application potential of biopolymer-based materials in various industrial and environmental contexts.

Dr. Sathi Sharma
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sathisharma1994@gmail.com

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Research Gate: https://jaipur.manipal.edu/fos/ faculty-list.php#

Research Interest & Personal Statement: I am working on experimental nuclear physics, specifically the astrophysical reactions important in stellar environment. I have worked with several gamma, neutron and charged particle detectors. I have characterized them using experimental techniques as well as using simulation software like GEANT4. I am also working on theoretical codes like OXBASH, NuShellX, WSPOT to calculate the structural properties like energy levels, transition probabilities, lifetime, spin and parity, level width of different nuclei. My recent research interest is to study different radionuclides using different light ion beams like proton, alpha and neutron. My interest is mainly measuring the production cross-section precisely of different radionuclides which have applications in nuclear medicine as well as in nuclear reactors.

Publications of 2023

Sharma, A., Vankayala, R., Misra, K.P., Bagaria, A., MoS2 nanoflower-Indocyanine green composite for enhanced optical imaging capabilities, Materials Technology 39(1).
Q2, I. F. = 3.1, https://doi.org/10.1080/10667857.2023.2291935

Abstract

To enhance the efficiency of painless targeted nanotherapies, integrating optical imaging capabilities into nanoplatforms is gaining momentum. Our study presents a cost-effective synthesis of MoS2 nanoflower (MNF) and Indocyanine green (ICG) composites (MNF-ICG) using a physical method based on van der Waals interactions. MNF, prepared via the hydrothermal method, underwent characterization through UV-vis, FTIR, and fluorescence spectroscopy, while FESEM and XRD techniques were employed to analyse morphology and structural phase. Through electrostatic interaction, ICG was absorbed onto the MNF surface. The resulting MNF-ICG demonstrated exceptionally high optical absorbance across a broad NIR spectra, facilitating longer-wavelength photothermic imaging with increased penetration depth. In comparison to MNF alone, the composite significantly enhanced the photothermal imaging sensitivity of nanoplatforms, exhibiting notable bathochromic and hyperchromic shifts in fluorescence intensity. This innovative approach holds promise for advancing nanotherapeutics with improved optical imaging capabilities.

Sharma, A., Bagaria, A., Morphology of MoS2 nanostructures: Insights into the solvent assisted exfoliation, AIP Conference Proceedings, 2723(1).
Q4, https://doi.org/10.1063/5.0139761

Abstract

The MoS2 nanostructures were prepared via hydrothermal route followed by liquid-phase exfoliation. The solvents used to produce single-layer Nanosheets were ethanol, acetone and bovine serum albumin (BSA) and the exfoliated products were characterized using scanning electron microscopy, X-ray diffraction, photoluminescence spectroscopy and ultra-violet spectroscopy. The MoS2 nanostructures synthesized through hydrothermal method further followed by BSA assisted exfoliation showed better morphology as compared to other organic solvents. Our results confirm that BSA acts not only as a good exfoliating agent but is also a potential biopolymer against the reconglomeration of single layer nanosheets. This in turn is beneficial in improving the biocompatibility of MoS2 in biomedical applications.

R. Biswal, P. Yadav, B. Khan, Pushpendra Kumar, M. K. Singh, Synthesis, dielectric, and magneto – dielectric properties of carbon quantum dots/ZnFe2O4 hybrid nanocomposite, FERROELECTRICS, 616, 53-69.
Q4, I. F. = 0.8, https://doi.org/10.1080/00150193.2023.2269160

Abstract

Carbon quantum dots doped $ZnFe_2O_4$ Spinel Ferrite, that is, CQD-ZSF hybrid nanocomposite was thrivingly synthesised exploiting sol-gel based synthesis technique. Structural assessment supports Fd-3m space group with cubic spinel structure with mean size of 10.33nm as obtained from Scherrer formula. Raman spectra confirmed the existence of CQD in ZSF. The samples contained a variety of vibration bands, according to the FT-IR analysis. The dielectric permittivity (ε) and tangent losses (tan δ) was conducted with frequency from 100Hz to 1MHz range at different temperatures ranging from 300 to 773 K. It was found that ε as well as tan δ receded monotonously with extending frequency. This information reveals a space or interfacial dipolar relaxation phenomenon. The electrical properties and the ion hopping dynamics were probed with the assistance of an AC-electrical conductivity (σ_{ac}) analysis. Frequency-dependent σ_{ac} heeded Jonscher's law of power. The advent of arcs semicircular by nature in cole-cole plot indicates cloud of electronic process occurring within sample. At 300K, by applying an external magnetic field varying till 1.5 Tesla magnetic field, the magneto-dielectric effects of the sample were measured by obtaining ε and tan δ versus frequency values displaying negative ML% (magneto-loss) and MD% (magneto-dielectric) coupling of −32.57% and −58.13%, respectively.

Pushpendra Kumar, R. S. Pandhre, N. Suthar and R. Singhal, Study of Surface Morphology of Palladium Overlayer on Switchable Samarium Hydride Thin Films, NanoWorld J, 9 (2023) S236- S239.
Q4, I. F. = 1.53, https://doi.org/10.17756/nwj.2023-s5-046

Abstract

A reversible metal-to-semiconductor transition was attained in samarium thin films covered with several thicknesses of palladium (Pd) coating during *in-situ* hydrogen loading by applying normal pressure of hydrogen gas at ambient temperature. The electrical change is followed by extreme variations in optical properties in the visible range, where the metallic gray color of samarium thin films switched to golden greenish tinge transparent films upon hydrogen absorption. The thickness of Pd overlayer shows a decisive role in this switching phenomena and we have studied the effect of Pd overlayer thickness using electrical, optical and scanning electron microscopy (SEM) measurements. Electrical measurements reveal that Pd overlayer on samarium films is discontinuous only for thicknesses of less than 3 nm. SEM studies indicate significant changes in surface morphology of Pd overlayer as a function of its thicknesses. The micrographs reveal a gradual variation in the average size of the spherical crystallites with increasing thickness of Pd overlayer. Cracking of Pd grains has been observed on hydrogenation if the underlying samarium film thickness is >100 nm. Results of electrical and optical changes upon hydrogenation/dehydrogenation are presented.

P. Yadav, A. Pandey, B. Khan, Pushpendra Kumar, A. Kumar, M. K Singh, Structural, optical, dielectric, and magneto-dielectric properties of Ca^{2+} modified $BiFeO_3$ multiferroics, Journal of Materials Science: Materials in Electronics, 34, 2043.

Q2, I. F. = 2.78, https://doi.org/10.1007/s10854-023-11444-0

Abstract

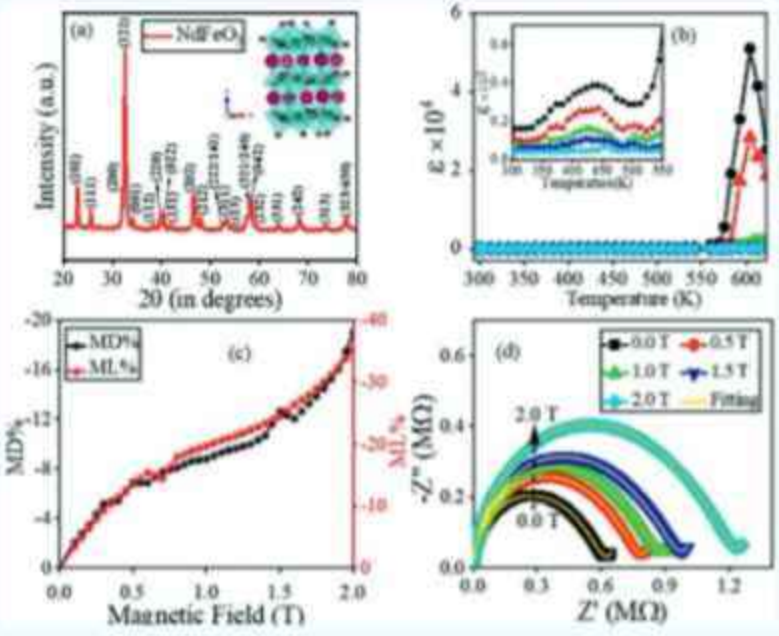
We report the synthesis and characterization of low leakage and large magneto-dielectric (MD) sol-gel derived $Bi_{1-x}Ca_xFeO_3$ (x=0, 5%, 10%) [BCFO] nanocrystalline multiferroic ceramics. The X-ray diffraction (XRD) data analysis revealed a rhombohedral structure for pure $BiFeO_3$ (BFO) and 5% Ca-doped BFO, as well as a mixture of rhombohedral and orthorhombic *(R3c+Pbnm)* structures for 10% Ca-doped BFO. The dielectric permittivity (ε) data exhibit anomalous dielectric behavior near the magnetic phase transition temperature of BFO, supporting the presence of the MD effect at room temperature. At room temperature, 10% Ca-doped BFO exhibits a strong magneto-dielectric coupling (MD) and shows positive MD effects. The frequency-dependent ac conductivity follows modified Jonscher's power law. Incorporating Ca reduces the leakage current by five orders of magnitude (for x=10%) and significantly improves the MD coupling. The optical band gap also significantly reduced from 2.24 to 1.70 *eV* after calcium substitution, which makes it suitable for use in photovoltaic applications.

Preeti Yadav, A. Pandey, B. Khan, R. Biswal, A. Fahad, Pushpendra Kumar, M. K Singh, Detailed investigation on structural, optical, dielectric and magneto-dielectric properties with enhanced magneto impedance characteristic of NdFeO3 nanoparticles, Materials Chemistry and Physics, 309, 128424.

Q1, I. F. = 4.78, https://doi.org/10.1016/j.matchemphys.2023.128424

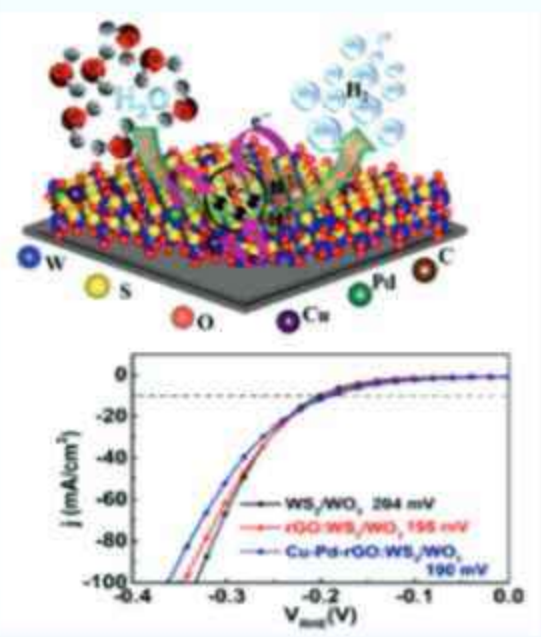
Abstract

$NdFeO_3$ (NFO) was synthesized using sol-gel citrate method and subsequent calcination at 1023 K. Utilizing Rietveld refinement analysis of the XRD pattern, it has been verified that NFO exhibits an orthorhombic crystal structure, with space group *Pbnm*. NFO grains were seen to be strongly agglomerated in a SEM image, despite their irregular shapes. The analysis of optical properties revealed a transmittance range of 20%–50% and an optical band gap of 2.15 eV for the NFO material. The dielectric properties of NFO were analyzed with respect to their dependence on frequency and temperature, while the ac electrical conductivity was studied in terms of its frequency variation. The dielectric dispersion behavior of NFO is explained by Maxwell Wagner-type polarization. A negative magneto-dielectric (MD) coupling of −19% and −35% was measured for ε and tanδ at 1 kHz for NFO. Magneto-impedance measurements on NFO showed positive magneto-resistance and both positive and negative magneto-capacitance, suggesting that the grain effect had a substantial role in the material's magnetic properties. These results suggest that NFO is an excellent choice for memory-based electronic devices with an appropriate band gap for optoelectronic applications having a large MD effect.



V. Kumar, R. K. Mishra, L. G. Trung, Pushpendra Kumar, S. M. Mane, J. C. Shin, J. S. Gwag, Copper, Palladium, and Reduced Graphene Oxide Co-Doped Layered WS2/WO3 Nanostructures for Electrocatalytic Hydrogen Generation, Electronic Materials Letters.
Q2, I. F. = 3.151, https://doi.org/10.1007/s13391-023-00458-9

Abstract



Fossil fuels have a vital role in global energy resources. The burning of fossil fuels produces pollutants and harms the environment. These environmental problems can be solved by searching for a substitute for fossil fuels. Hydrogen production by water electrolysis has emerged as a promising substitute. It is a green, clean, and renewable energy source. Low-cost water is abundant on the Earth. The metal and its composite material have been used to develop water electrolysis. Among these composite catalytic materials, WS_2/WO_3 composite catalyst is well-known for its excellent physical and chemical behavior in water electrolysis to produce hydrogen. Engineered catalysts can further enhance the catalytic performance. Therefore, we investigate and analyze the catalytic performance of copper (Cu), palladium (Pd), and r-GO co-doped WS_2/WO_3 composite material for water electrolysis to produce green, clean, and renewable hydrogen energy by hydrogen evolution reaction (HER). The hydrothermal synthesis method is used to prepare the WS_2/WO_3 composite material co-doped with Cu, Pd, and r-GO. The co-doping is favorable for fast charge transfer by providing many active catalytic sites for HER and enhancing the HER catalytic performance. Therefore, the co-doped tungsten disulfide/oxide could be a potential composite material for efficient water electrolysis for clean and renewable hydrogen production by electrochemical water electrolysis.

Akash, Harish, Jyoti Kumari, Anoop Kumar Mukhopadhyay, Pushpendra Kumar, Effect of Synthesis Process on the Properties of Nitrate Doped Calcium Hydroxide Nanomaterials, AIP Conference Proceedings, 2723, 020021.
https://doi.org/10.1063/5.0139070

Abstract

Nitrate doped calcium hydroxide nanomaterials have shown the great potential in several application that includes thermochemical heat storage and act as catalyst to produce diesel. In this work, we report the synthesis of nitrate doped calcium hydroxide nanomaterial. The calcium hydroxide was synthesis by simple chemical methods. The doping of nitrate in calcium hydroxide was done at room temperature and at 60°C. All the prepared three samples i.e. calcium hydroxide, calcium hydroxide doped with nitrate at room temperature and calcium hydroxide doped with nitrate at 60°C was characterized using X-ray diffraction (XRD), Field emission scanning electron microscope (FESEM) and UV-Vis spectroscopy techniques. From UV-Vis spectroscopic results, it was seen that in comparison of calcium hydroxide, the band gap of calcium hydroxide doped with nitrate at room temperature increases and the band gap of calcium hydroxide doped with nitrate at 60°C decreases. The obtained results are discussed in term of reaction kinetics.

V. Kumar, H. Jeon, Pushpendra Kumar, R. Ahuja, J. S. Gwag, Two-dimensional (2D) MT2 (M=Ba, Hf, Si, Sr and T=F, O) monolayers for possible electronic and optoelectronic applications, Optical and Quantum Electronics, 55, 893. Q2, I. F. = 2.8, https://doi.org/10.1007/s11082-023-05121-z

Abstract

The present work shed light on the structural, electronic, dielectric, and optical properties of MT_2 (M=Ba, Hf, Si, Sr and T=F, O) two-dimensional (2D) monolayers using density functional theory. The investigated electronic properties indicate that these 2D monolayer materials exhibit insulating properties. The complex dielectric function is calculated to investigate the optical functions of these monolayer materials. The dielectric and optical calculations are performed for the electric field vectors' orientation parallel (E||x, i.e., in-plane direction) and perpendicular (E||z, i.e., out-of-plane direction) to the plane of these 2D monolayer materials in the energy range 0–60 eV. It is noticed that the dielectric and optical responses of BaF_2, HfO_2, and SrF_2 are shifted toward the lower energy in the ultraviolet (UV) region compared to SiO_2. It may be attributed to their larger ionic radii. Due to a similar chemical environment, the studied properties show similar behavior in BaF_2 and SrF_2. These 2D materials offer high absorption of incident light in a wide energy range of UV region, hence the higher extinction coefficient. The obtained reflection and transmission coefficients in the vacuum ultraviolet (VUV) wavelength region suggest the potential candidature of these materials for VUV optical coatings, such as reflection, bandpass, absorption edge filters, and avoiding solar heating. BaF_2 and SrF_2 can combine to make low–high refractive index pair material with high refractive index HfO_2. The present results indicate that these 2D monolayer materials may be potential candidates for designing optical, photonic, and optoelectronic devices.

J. Kumari, Harish, Akash, A. Pandey, Pushpendra Kumar, M. K. Singh, R. P. Joshi and A. K. Mukhopadhyay, Nanostructured Calcite Thin Films by Dip Coating, AIP Conference Proceedings, 2752, 020005. https://doi.org/10.1063/5.0136027

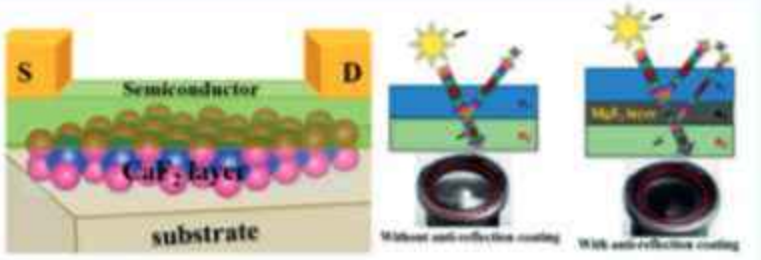
Abstract

Here we report for the first time to the best of our knowledge the synthesis of ultrathin calcite films by simple alternate dipping of pre-cleaned glass substrate in a calcium metal salt solution and a base solution. Deposited thin films were characterized by XRD, FESEM, FTIR and UV-Vis spectroscopy techniques. The XRD results confirmed the phase purity while depending on the number of dips either a micro/nano-brick morphology or a micro/nano flower morphology are noted in the microstructures studied by the FESEM technique. These results are discussed in terms of nucleation and growth of film on the substrate. Due to its non-toxic and biocompatible nature, these films can have applications in biosensors and photocatalysis.

V. Kumar, R. K. Mishra, H. Jeon, Pushpendra Kumar, R. Ahuja, J. S. Gwag, First-principles calculations to investigate the dielectric and optical anisotropy in two-dimensional monolayer calcium and magnesium difluorides in the vacuum ultraviolet, Journal of Physics and Chemistry of Solids, 181, 111482.
Q1, I. F. = 4.38, https://doi.org/10.1016/j.jpcs.2023.111482

Abstract

Anisotropic dielectric and optical properties of two-dimensional (2D) calcium and magnesium difluorides were investigated in the vacuum ultraviolet (VUV) region of the electromagnetic spectrum (EM) using the first principles density functional theory (DFT). The anisotropy between the in-plane and out-of-plane directions shows that these materials are uniaxial, exhibiting optical and dielectric anisotropy. The optical functions of these anisotropic materials-optical absorption, photoconductivity, refractive index, reflection and extinction coefficients, and electron energy loss (EEL) spectra-are calculated in the framework of DFT. The low refractive index values and relatively small extinction coefficient make these materials alternative low-index 2D materials for the long wavelengths in the VUV region of the EM spectrum. The reflection and transmission spectra indicate the antireflective property of these materials. The calculated EEL function shows less energy loss of fast-traveling electrons in the material's medium. The maxima in the EEL spectrum are the main feature of plasma oscillations. The dissipation in the incident light radiation energy propagating through the dielectric medium is estimated with the dielectric loss tangent (tanδ). The magnesium difluoride is identified as a less dielectric loss medium than calcium difluoride in the VUV region. The present results suggest that these 2D materials are promising in low refractive index, high reflective, and antireflective coating materials in optoelectronic device applications. Also, electronic studies revealed that these are excellent materials for gate insulators in field-effect transistors based on 2D electronic materials.



Showing the application of 2D CaF_2 insulating layer in electronic device (left) and 2D MgF_2 antireflection coating layer in optical device (right)

A. Singh, D. Agarwal, Pushpendra Kumar and M. S. Shishodia, Fano Resonances in Graphene Coated Refractory Nitride Nanoshell and Nanomatryoshka for Sensing Food Adulteration, Applied Physics A, 129, 366.
Q2, I. F. = 2.98, https://doi.org/10.1007/s00339-023-06651-9

Abstract

Recent advancements in nanotechnology have made it feasible to excite, control and tune Fano resonance in plasmonic nanosystems, especially through structural and material engineering. Because of various applications in areas such as refractive-index sensing, surface enhanced Raman scattering, and biosensing among others, considerable attention has been devoted to increase the sensitivity of Fano resonance-based sensors. In this article, the formation of Fano resonances in graphene-assisted concentric nanoshell and nanomatryoshka is investigated using Mie theory, and the results have been validated using FEM-based COMSOL Multiphysics. It is shown that Fano resonances strongly depend on the chemical potential of graphene and the refractive index of the embedding environment. This makes these nanoparticle systems ultrasensitive sensors for sensing food adulteration. Refractory nitrides (e.g., ZrN and TiN) based plasmonic nanoshell and nanomatryoshka sensor designs optimized for maximum sensitivity are proposed with sensitivity up to 799.02 nm/RIU, representing a 120% increase in the sensitivity from the previous highest reported values. The present work paves way for developing highly sensitive Fano resonance based sensors with applications in diverse fields.

A. Sharma, P. Yadav, B. Khan, Pushpendra Kumar and M. K. Singh, Structural, Electrical and Optical Properties of Ca0.5Sr0.5SnO3 nanoparticle prepared by sol-gel method, Material Todays: Proceedings, 82, 308-313.
https://doi.org/10.1016/j.matpr.2023.02.007

Abstract

The nanocrystalline powder of $Ca_{0.5}Sr_{0.5}SnO_3$ was synthesized by the sol–gel technique. The synthesized sample was extensively examined for its structural, morphological, electrical, vibrational, and optical properties. Using Rietveld refinement, it is investigated that the XRD data of synthesized $Ca_{0.5}Sr_{0.5}SnO_3$ fits in an orthorhombic crystalline structure having the space group *Pnma*. The sample's optical characteristics demonstrate a strong UV absorption. The optical bandgap of the sample was discovered to be 4.02 eV. At various temperatures, the dipolar relaxation phenomenon was observed as a function of frequency. It was discovered that (ε) and ($tan\delta$) decrease with increasing frequency. As temperature increases, dielectric permittivity (ε) increases abruptly above 650 K associated with structural phase transition, and it also shows an anomalous behavior between 300 K and 350 K that may be associated with order–disorder phase transition. An electrical conductivity study of $Ca_{0.5}Sr_{0.5}SnO_3$ was performed to demonstrate that the sample exhibits a temperature-dependent hopping mechanism. When the temperature of $Ca_{0.5}Sr_{0.5}SnO_3$ rises above 510 K, its conductivity value also increases rapidly, indicating the samples behave like semiconductors which leads to its application as condensers, lithium-ion batteries, and more recently, as humidity sensors.

V. Kumar, R. K. Mishra, Pushpendra Kumar, L. G. Trung, J. S. Gwag, Strong anisotropic optical response in two-dimensional Mo-VIA and Mo-VIIA monolayer binary materials, Photonics and Nanostructures - Fundamentals and Applications, 53, 101114.
Q2, I. F. = 3.0, https://doi.org/10.1016/j.photonics.2023.101114

Abstract

Two-dimensional binary materials based on transition metals have attracted much research attention because of their intriguing physical properties owing to their crystalline structure. The optical response of these compounds paves a way to manipulate the optical and electronic properties for optical and electronic device applications. Here, the frequency-dependent anisotropic linear optical response of eight molybdenum (Mo)-based binary materials from the VIA (i.e., O, S, Se, and Te) and VIIA (i.e., F, Cl, Br, and I) groups are systematically investigated using first-principles density functional theory. These binary materials exhibit strong linear anisotropic dielectric and optical behavior in the low energy range and become isotropic at high energies. The linear anisotropy in optical functions can be attributed to the intralayer excitonic behavior. The phenomenon of birefringence is the main characteristic of anisotropic materials. The dichroic ratio determines the degree of anisotropy. Among these binary materials, MoS_2 and $MoCl_2$ show large birefringence in the visible and far-infrared regions. The birefringence in these materials is also compared with other reported materials. Birefringence is critical for light manipulation during propagation through media. The present results provide insight into the linear optical anisotropies of the binary materials considered. Furthermore, the results suggest that these Mo-based binary materials could be potential candidates for developing optical instruments, optoelectronic, and photonic device applications.

R. K. Mishra, V. Kumar, Le Trung, G. Choi, J. Ryu, P. Kumar, R. Bharadwaj, S. Lee,J. S. Gwag, Bifunctionality of MoS2 nanolayer catalyst for water-splitting reactions of hydrogen and oxygen, Materials Letters, 338, 134026.
Q1, I. F. = 3.4, https://doi.org/10.1016/j.matlet.2023.134026

Abstract

This letter shows the solvothermal method synthesized MoS_2 nanolayers for oxygen evolution reaction (OER) and hydrogen evolution reaction (HER) applications. The evaluated overpotential values of OER and HER of the MoS_2 catalyst are 340 mV and 136 mV. The calculated values of OER and HER Tafel slopes are 189 mV dec^{-1} and 120 mV dec^{-1}. In addition, the EIS spectra outline the charge-transfer resistances of 9.72 Ω and 11.87 Ω and series resistances of 0.78 Ω and 1.06 Ω of HER and OER. Furthermore, the HER reaction mechanism has been discussed to illustrate insights into the MoS_2 nanolayer catalyst to explore its tremendous catalytic capabilities.

V. Kumar, R. K. Mishra, G. J. Choi, J. W. Ryu, Pushpendra Kumar, J. S. Gwag, Optical and dielectric response of two dimensional WX 2 (X=Cl, O, S, Se, Te) monolayers: a comprehensive study based on density functional theory, Luminescence, 38, 1368-73.
Q2, I. F. = 2.61, https://doi.org/10.1002/bio.4453

Abstract

Here, we study the dielectric and optical properties of two-dimensional (2D) WX_2 monolayers, where X is Cl, O, S, Se, and Te. First principle electronic band structure calculations reveal that all materials are direct band gap semiconductors except WO_2 and WCl_2, which are found to be indirect band gap semiconducting 2D materials. The dielectric response of these materials is also systematically investigated. The obtained results suggest that these materials are suitable as dielectric materials to suppress unwanted signal noise. The optical properties of these 2D materials, such as absorption, reflection and extinction coefficients, refractive index, and optical conductivity, are also calculated from the dielectric function. It is found that these materials exhibit excellent optical response. The present electronic, dielectric, and optical findings indicate that WX_2 monolayers have an opportunity in electronic, optical, and optoelectronic device applications.

R. Biswal, P. Yadav, B. Khan, Harish, Pushpendra Kumar, M. K. Singh, Synthesis, dielectric and optical properties of Carboxyl Functionalized FeFe2O4 Hybrid Nanocomposite (CFFHN), Materials Today: Proceedings, 82, 255-262.
https://doi.org/10.1016/j.matpr.2023.01.183

Abstract

Magnetite ($FeFe_2O_4$) nanoparticles (NPs) and Carboxyl Functionalized $FeFe_2O_4$ hybrid nanocomposite (CFFHN) were successfully synthesized utilizing sol–gel-based synthesis method. Both samples have *Fd*-3 m space group-containing cubic structure (spinel phase) which has been demonstrated by X-ray Diffraction measurements. The average crystallite sizes of $FeFe_2O_4$ and CFFHN crystals as calculated using Debye-Scherrer's equation were 29.11 nm and 21.63 nm, respectively. The crystallite size (L) and micro-strain (ε) for the $FeFe_2O_4$ sample were obtained to be 39.25 nm and 3.12×10^{-3} respectively and for CFFHN to be 30.72 nm and 2.45×10^{-3} respectively. The results for L obtained from W-H plot are found to be greater than that of Debye Scherrer value, indicating that the samples' crystal structures are strained and doped, with Ɛ also playing a role. FTIR measurements showing correctly generated doped ferrite NPs indicated surface functionality. The band gap of $FeFe_2O_4$ and CFFHN is found to be about 2.12 eV and 2.72 eV respectively by using the Tauc Plot method. Dielectric permittivity (ε) of $FeFe_2O_4$ and CFFHN are certified by the phenomenon involving dipolar-relaxation. The magneto-dielectric effect is also seen for ε and tangent loss (tan δ) for both $FeFe_2O_4$ and CFFHN.

P. Yadav, A. Pandey, B. Khan, R. Biswal, Pushpendra Kumar, M. K. Singh, Rietveld refinement, dielectric, magneto-dielectric effect and optical properties of (Ca/Hf) co-doped Bisumth Ferrite, Materials Today: Proceedings, 82, 227-233.
https://doi.org/10.1016/j.matpr.2023.01.121

Abstract

Multiferroic $Bi_{0.9}Ca_{0.1}Fe_{0.9}Hf_{0.1}O_3$ nanoparticles was synthesised by using sol–gel technique. The formation of the compound is examined using X-ray diffraction pattern and then verified by Rietveld refinement with FULLPROF software. FTIR spectra confirms the existence of metal–oxygen bands which confirms the creation of a perovskite structure. With increasing frequency, there is a drop in dielectric permittivity (ε) and tangent loss (*tanδ*), which can be explained by the dipolar relaxation phenomena. With respect to rising temperature, dielectric permittivity is increasing, exhibiting dielectric anomalies (like a hump) at a particular region, these anomalies get diminished in tangent loss. Additionally, the synthesised sample also displays a strong magneto-dielectric (MD) effect with applied magnetic field (0 T to 1 T). Synthesized sample's band gap (Eg) absorption was calculated using the Tauc's formula, and it was reduced as compared with the pure BFO sample. Strong MD coupling and reduced band gap makes it prominent candidate for magneto-dielectric and optoelectronic devices.

A. Pandey, P. Yadav, Pushpendra Kumar and M. K. Singh, Synthesis, morphological and optical properties of hydrothermally synthesized Bi and Mn co-doped Cu2ZnSnS4 (CZTS) Material Todays: Proceedings, 82, 85-90.
https://doi.org/10.1016/j.matpr.2022.11.407

Abstract

Cu_2ZnSnS_4 (CZTS) is a multifunctional material that has gained a lot of interest as a new solar cell material for photovoltaic applications because of its abundance in earth, purity and high stability. In this work, $Cu_2Zn_{1-x}(Bi-Mn)_xSnS_4$ (x = 0, 0.05 and 0.1 as C1, C2 and C3 respectively) nanoparticles have been synthesized using a cost-effective and environmentally sustainable hydrothermal technique. The synthesized samples are characterized by X-ray Diffraction (XRD), which confirms the presence of CZTS tetragonal crystal structures. The morphology and the effective grain size of the prepared samples have been observed by Field Emission Scanning Electron Microscopy (FESEM). The average crystallite size is calculated using Scherrer's formula reflecting the decrease in the size of particles with doping i.e. 6.76, 6.40 and 5.95 nm for C1, C2 and C3 respectively. Also, W-H plot is used to calculate the strain developed in the lattice due to substitution. With the use of an FTIR spectrophotometer, an additional study into the vibrational stretching of various bonds found in various samples was conducted. The absorbance plot is used to estimate the bandgap of the synthesized samples. In the visible spectrum, there is a significantly strong absorption with a prolonged tail stretching to higher wavelengths. The optical bandgap of the samples is determined using the Tauc plot, and it was discovered to be lowering with the rise in doping concentration (C1 ~ 1.60 eV, C2 ~ 1.57 eV and C3 ~ 1.53 eV) which is ideal for solar cell applications. It is concluded that the doping of CZTS with Bi and Mn makes it a better photovoltaic material having low bandgap and efficient photovoltaic properties.

R. K. Mishra, V. Kumar, L. G. Trung, G. J. Choi, J. W. Ryu, R. Bhardwaj, Pushpendra Kumar, J. Singh, S. H. Lee, J. S. Gwag, Recent Advances in ZnO Nanostructure as a Gas Sensing Elements for Acetone Sensor: A short review, Luminescence, 38, 1087-01.
Q2, I. F. = 2.9, https://doi.org/10.1002/bio.4413

Abstract

Air pollution is a severe concern globally as it disturbs the health conditions of living beings and the environment because of the discharge of acetone molecules. Metal oxide semiconductor (MOS) nanomaterials are crucial for developing efficient sensors because of their outstanding chemical and physical properties, empowering the inclusive developments in gas sensor productivity. This review presents the ZnO nanostructure state of the art and notable growth, and their structural, morphological, electronic, optical, and acetone-sensing properties. The key parameters, such as response, gas detection limit, sensitivity, reproducibility, response and recovery time, selectivity, and stability of the acetone sensor, have been discussed. Furthermore, gas-sensing mechanism models based on MOS for acetone sensing are reported and discussed. Finally, future possibilities and challenges for MOS (ZnO)-based gas sensors for acetone detection have also been explored.

V. Kumar, R. K. Mishra, Pushpendra Kumar, and J. S. Gwag, A comprehensive study on the electronic structure, dielectric and optical properties of alkali-earth and transition metal hydroxides $M(OH)_2$, Luminescence, 38, 1307-18.
Q2, I. F. = 2.9, https://doi.org/10.1002/bio.4405

Abstract

In the present work, the physical properties of alkali-earth metal and transition metal hydroxides are comprehensively investigated using the density functional theory. Here, the alkali-earth metals Ca, Mg, and transition metals Cd, Zn are considered from the II-A and II-B groups in the periodic table of elements. The first principle electronic structure calculations show that these bulk hydroxide materials are direct band gap material. $Ca(OH)_2$ and $Mg(OH)_2$ exhibit an insulating behavior with a very large band gap. However, $Cd(OH)_2$ and $Zn(OH)_2$ are found to be wide band gap semiconductors. The dielectric and optical studies reveal that these materials have a high degree of anisotropy. Hence, the light propagation in these materials behaves differently in the direction perpendicular and parallel to the optical axis, and exhibits birefringence. Therefore, these materials may be useful for optical communication. The calculated electron energy loss suggests that these materials can also be used for unwanted signal noise suppression. The wide band gap makes them useful for high-power applications. Moreover, $Ca(OH)_2$ and $Mg(OH)_2$ are found to be suitable for dielectric medium.

Akash, Harish, V. Kumar, R. K. Mishra, J. S. Gwag, R. Singhal, A. K. Mukhopadhyay, Pushpendra Kumar, Microstructural Tuning and Bandgap Engineering of Calcium Hydroxides: A Novel Approach by pH Variation, Luminescence, 38, 1297-06.
Q2, I. F. = 2.9, https://doi.org/10.1002/bio.4412

Abstract

Here we report a simple, inexpensive, energy benign, yet novel pH-driven chemical precipitation technique to achieve microstructural and band gap engineering of calcium hydroxide nanoparticles (CHNPs). The chemical precipitation route involved the use of 0.4–1.6 M $Ca(NO_3)_2.4H_2O$ solutions as the precursor and 1 M NaOH solution as the precipitator. The simple variation in precursor molarity induces a pH change from about 12.4 to 11.3 in the reactant solution. The CHNPs characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), dynamic light scattering (DLS), and ultraviolet–visible (UV–Vis) spectroscopy techniques confirm a jump of nanocrystallite size from ~50–70nm with a concomitant reduction of direct optical band gap energy from ~5.38–5.26eV. The possible mechanisms that could be operative behind obtaining microstructurally tuned (MT)-CHNPS and band gap engineering (BGE) are discussed from both theoretical and physical process perspectives. Furthermore, the implications of these novel results for possible futuristic applications are briefly hinted upon.

Anshu Soni, Harish, Akash, V. Kumar, R. K. Mishra, J. S. Gwag, N. K. Poddar, R. Singhal, A. K. Mukhopadhyay, Pushpendra Kumar, Optical Band Gap Enhancements of Chemically Synthesized α-$Ni(OH)_2$ nanoparticles by a Novel Technique: Precipitator Molarity Variation, Luminescence, 38, 1287-96.
Q2, I. F. = 2.9, https://doi.org/10.1002/bio.4398

Abstract

Nickel hydroxide nanoparticles (NHNPs) are extremely important semiconducting materials for applications in energy storage and energy harvesting devices. This study uses a novel variation in molarity of the sodium hydroxide (NaOH) precipitator solution to enhance the direct optical band gap in the NHNPs chemically synthesized by using nickel nitrate hexahydrate ($Ni(NO_3)_2{\cdot}6H_2O$) as the precursor. The simple, energy benign chemical precipitation route involved the usage of 1 M ($Ni(NO_3)_2{\cdot}6H_2O$) solutions as the precursor and 0.4 M, 0.6 M, and 0.8 M NaOH solutions as the precipitator solutions. The simple variation in precipitator molarity induces an increase in pH from about 6.9 to 7.5 of the reactant solution. As the molarity of the precursor solution does not change, the change in pH of the reactant solution is equivalent to the change in the pH of the precipitator solution. The NHNPs characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), dynamic light scattering (DLS), Fourier-transform infrared (FTIR) and ultraviolet-visible (UV-vis) techniques confirm a reduction of the nanocrystallite size from about 6.8 to 4.5 nm with a concomitant enhancement in the direct optical band gap energy from about 2.64 to 2.74 eV. The possible mechanisms that could be operative behind obtaining microstructurally tuned (MT)-NHNPs and band gap engineering (BGE) of the MT-NHNPs are discussed from both theoretical and physical process perspectives. Further, the implications of these novel results for possible future applications are briefly touched upon. The reported results might be useful to assess the material as an active electrode to improve the performance of batteries.

Vipin Kumar, R. K. Mishra, Pushpendra Kumar, J. S. Gwag, Electronic and optical properties of Nb/V-doped WS2 monolayer: a first principles study, Luminescence, 38, 1215-20.
Q2, I. F. = 2.9, https://doi.org/10.1002/bio.4342

Abstract

The electronic, dielectric, and optical properties of pure and Nb/V-doped WS_2 monolayer are being investigated using the first-principles density functional theory (DFT). The electronic band structure calculations reveal that the pure and doped WS_2 monolayer is a direct band gap semiconductor. It is seen that the doping not only slightly reduces the band gap but also changes the n-type character of pure WS_2 monolayer to the p-type character. Hence, it may be useful for channel material in field effect transistors (FETs). Moreover, the optical studies reveal that the WS_2 monolayer shows a significantly good optical response. However, a small ultraviolet shift is observed in the optical response of the doped case compared to the pristine WS_2 monolayer. This study suggests that the WS_2 monolayer can be a possible optical material for optoelectronic applications, and it can also be a replacement of MoS_2-based future electronics and optoelectronics.

S. Rawal, Pushpendra Kumar, P. K. Singh, and A. K. Mukhopadhyay, Conducting Polymer Nanocomposites for Energy Storage Applications: Recent Progress and Future Challenges, Bulgarian Chemical Communications, 55, 146-156.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0023

Abstract

These days, the requirement of developing new energy storage devices to store large amount of energy in high-rate applications is increasing. Thus, the cconducting polymers (CPs) hold a good future in energy storage field. This is related to their flexibility, light weight, high conductivity (>103 S cm^{-1}), cost effectiveness, controlled resistance over a wide range and excellent electrochemical properties. In particular, these materials can be used as an active material in rechargeable batteries and supercapacitors. CPs-based pseudocapacitors are capable to deliver large amount of energy that can last millions of cycles. Therefore, the current review summarizes how the choice of monomers and physical characteristics of dopants affect the electrical behavior of polymers and their widespread applications. The possible challenges to be overcome for their futuristic developments are also identified.

M. Pandey, D. Palariya, S Mehtab, M.G.H. Zaidi, Pushpendra Kumar, Electrical behavior of graphite epoxy composite electrodes in humid environment, Bulgarian Chemical Communications, 55, 65-70.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0010

Abstract

The present study demonstrates the development of graphite (GR)-enriched epoxy composites for possible application as electrode materials for supercapacitors operating in humid environment. The study was conducted through development of a series of adhesive compositions involving epoxy resin supplemented with various proportions of GR (50 to 85 %w/w) and 4,4'-diaminodiphenyl sulfone (1%, w/w), followed by curing over stainless-steel current collectors at 110°C. This has afforded a series of working electrodes (WEs) with improved electrical conductivity. The effect of temperature and voltage on the electrical behavior of WEs at varying composition was investigated in humid environment (40%, RH). The study demonstrates that WEs involving 50 wt% of GR exhibit a 10% increase in σDC at 1 V under 40% RH, 40°C. Arrhenius plots revealed that the activation energies (Ea, J/mole) of WEs were dependent on GR concentration (50 to 75% w/w) and were found in the range of 2.10 to 4.76. In comparison to the humidity at room temperature (36% RH), the humidity exposure (40% RH) of WEs derived at 50 wt% GR has shown an increase in σDC by 7.69%

M. Pandey, P. Joshi, S. Mehtab, M. Aziz, M. Pandey, Pushpendra Kumar, M.G.H. Zaidi, Thermal degradation and kinetic analysis of fly ash enriched epoxy composites, Bulgarian Chemical Communications, 55, 71-76.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0011

Abstract

Present investigation demonstrates the enrichment of fly ash (FA, 27.23 nm) into cured epoxy resin (CE) and the study of the non-isothermal kinetic mechanism and thermodynamic data of solid-state decomposition under oxidative media. Thermal study and degradation behavior of FA-enriched polymer composite (FEPc) were determined by simultaneous thermogravimetric (TG) - differential thermogravimetric (DTG) - differential thermal analysis (DTA). The kinetic parameters of FEPc were measured through Coats–Redfern (CR) and Horowitz–Metzger (HM) models under best-fit analysis and further evidenced by linear regression analysis. FEPc revealed two step decomposition with improved TG onset by 25 oC over CE due to the inherent thermal stability of FA. Results demonstrated that thermal behavior, kinetic and thermodynamic parameters of FEPc were improved with the enrichment of FA into CE. HM and CR models at reaction orders (n) ranging from 0 to 3 revealed the steadiness in order of solid-state degradation for CE (n = 2), FA and FEPc (n = 1) with negative value of entropy difference. CR method calculated higher values of activation energy (Ea) over HM method. These applied methods delivered higher differences in the values of Ea, change in enthalpy and Gibbs free energy of solid-state degradations, but marginal changes in pre-exponential factor and change in entropy of FEPc over CE and FA. Kinetic and thermodynamic parameters disclosed modification in thermal stability of FEPc over CE due to the intrinsic thermal stability of FA.

L. Kumar, A. G. Chakinala, M. G. H. Zaidi, Pushpendra Kumar, Synthesis and characterization of metal doped molecular sieve- 5å based catalyst, Bulgarian Chemical Communications, 55, 59-64.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0009

Abstract

Conversion of waste to best in the form of valuable product using different catalysts is the need of present time for an emerging technological application. However, achieving the appropriate yield of best with negligible waste generation at low energy consumption is still a grand challenge. In the process of converting waste to best the catalyst plays an important role for green chemistry. In this report, we have synthesized metal, i.e., zinc- and iron-doped molecular sieve 5Å catalyst using chemical synthesis process. The synthesized catalyst was identified by diverse analytical techniques. Optical spectra revealed the reduction in band gap of metal-doped molecular sieve by 5Å, which was attributed to localized state formation within the band gap of base material molecular sieve 5Å. Such materials can find technological applications in green chemistry to convert waste into valuable chemicals.

J. Kumari, Pushpendra Kumar, R. Singhal, M. G. H. Zaidi and A. K. Mukhopadhyay, Effect of substrate on the properties of calcite thin films prepared by dip coating method, Bulgarian Chemical Communications, 55, 54-58.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0008

Abstract

We report on the development of calcite thin film on two different glass substrates. The first film was deposited on pre-cleaned glass substrate and another film was deposited on the glass substrate treated with dilute hydrofluoric acid (HF), using dip-coating. The films were synthesized by dipping glass substrate and etched glass substrate alternatively into calcium metal salt solution Ca (NO3)2.4H2O and NaOH base solution. Several techniques were used to characterize the thin films that include X-ray diffraction, Fourier transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM) and ultraviolet-visible spectroscopy (UV-Vis). From FESEM images of substrates it was observed that the etched sample has higher roughness than the plain glass substrate. Accordingly, the effect of roughness was monitored on the morphology of deposited calcite thin films. The rough surface of substrate lead to a bigger crystallite size of calcite thin films as calculated by XRD peaks and also observed in FESEM image. Subsequently, from optical studies, the bandgap of the thin films was found to decrease with increase in crystallite size. The present study on the calcite thin films might pave the way to understand the thin films and further use them in several applications in sensors, biomedical, environmental, and for fundamental research.

Akash, R. Singhal, M. G. H. Zaidi, S. Rawal, A. K. Mukhopadhyay, Pushpendra Kumar, Effect of calcination on nickel doped calcium hydroxide nanoparticles, Bulgarian Chemical Communications, 55, 5-11.
Q4, I. F. = 0.5, DOI: 10.34049/bcc.55.A.0001

Abstract

In this study, we have synthesized calcium hydroxide (CH) and nickel (Ni)-doped calcium hydroxide nanoparticles (NPs), through the inexpensive chemical precipitation route. The nickel-doped CHNPs were then calcined at 500 °C for 3 hours. The produced samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive X-ray (EDX), Fourier transform infrared spectroscopy (FTIR), and UV-visible spectroscopy techniques to investigate the changes in structural, morphological and optical parameters. The XRD study showed the phase formation of Ca(OH)2, Ni-Ca(OH)2, and CaCO3. The Ca(OH)2 nanoparticles were transformed into CaCO3 NPs due to the high-temperature carbonation reaction. It was also found that the crystallite size is decreasing from 62.32 nm to 40 nm. The FESEM pictures expose the prepared samples' morphology and particle size. The UV-Vis spectra showed a blue shift in the absorbance band. The band gap energy of all prepared samples, plotted by Tauc's plot, showed a concomitant change with crystallite size.

A. Jain, P.K. Sharma, S.K. Jain, J.K. Deegwal, G. Saxena, Cluster radioactivity in trans-lead region: A systematic study with modified empirical formulas, Nuclear Physics A, 1031/122597.
Q2, I. F. = 1.742, https://doi.org/10.1016/j.nuclphysa.2022.122597

Abstract

The possibility of cluster emission from trans-lead ($86 \leq Z \leq 96$) region of periodic chart has been explored comprehensively by employing few empirical formulas which are modified by adding angular momentum (l) or isospin-dependent ($I = (N-Z)/A$) or both terms for the calculation of cluster decay half-lives. These modified versions of the formulas are found with lesser $\chi 2$ per degree of freedom and root mean-square error, in addition to the smaller values of some other statistical parameters, while compared to their corresponding old versions on available 61 experimental data of cluster radioactivity. By applying the modified version of the formula given by Balasubramaniam et al. (2004) [12], the most accurate formula among these, half-lives of several clusters i.e. isotopes of Be, B, C, N, O, F, Ne, Na, Mg, and Si are predicted systematically for the several isotopes in the trans-lead region. The contest of cluster emission with α-decay has been investigated in form of branching ratio which brings several potential cluster emissions into the probable decay modes of these nuclei. The accurate prediction of half-lives of such clusters is expected to be crucial for the future experimental observations where α-decay is observed dominantly.

Dinesh Kumar Yadav, Anju Yadav, Sushil Kumar Jain, Narendra Jakhar, Balram Tripathi, A Decisive Study on Dielectric Response of Bi_2O_3/Polystyrene & Bi_2O_3/PVDF Composite as Flexible Electrodes for Energy Storage, Open Journal of Composite Materials, Vol.13 No1.
Q3, I. F. = 2.9, https://doi.org/10.4236/ojcm.2023.131001

Abstract

In this manuscript a comparative study on Bi_2O_3/polystyrene and Bi_2O_3/PVDF composites has been executed via analysis of structural, bonding, surface morphology and dielectric response of composites for energy storage. The composites have been synthesized using solution cast method by varying concentrations of Bi_2O_3 (BO = 1 - 5 mw%) into polystyrene (PS) and polyvinylidene fluoride (PVDF) polymers respectively. X-ray diffraction confirms the generation of crystallinity, Fourier transform infrared (FT-IR) spectroscopy confirms bonding behavior and scanning electron microscopy (SEM) confirms uniform distribution of Bi_2O_3 (BO) in PS and PVDF polymers. Impedance spectroscopy has been employed for determination of dielectric response of the fabricated composites. The dielectric constant has been found to be increased as 1.4 times of pristine PS to $BO_{5\%}PS_{95\%}$ composites and 1.8 times of pristine PVDF to $BO_{5\%}PVDF_{95\%}$ composites respectively. These high dielectric composite electrodes are useful for flexible energy storage devices.

Jagmohan Lal Sharma, S.K. Jain, Balram Tripathi, Mahesh Chandra Mishra, –To Study the Cadmium Sulphide Thin Films Synthesis by Simple Spin Coating Method for Energy Application DOAJ EAST EUROPEAN JOURNAL OF PHYSICS, 3, 599-605.
Q4, I. F. = 0.179, https://doi.org/10.26565/2312-4334-2023-3-71

Abstract
The paper examines the properties of CdS thin film, which is used for window material of solar cells and optical devices. The cadmium sulfide (CdS) thin film was prepared by sol-gel method on glass and ITO substrate. Prepared thin film dried in a vacuum oven at 70°C. Thin film and powder of CdS characterized for structural, optical, and electrical properties by X-ray Diffractometer (XRD), UV-Visible spectrometer, and Keithley spectrometer. The average crystallite sizes, microstrain, and dislocation density of the samples were calculated by the Debye Scherrer formula. The optical band gap of CdS calculated by the Tauc-plot method and obtained 2.40 and 2.41eV for powder and film. The absorption wavelength of CdS is suddenly decreased near 280nm and becomes flat in the higher wavelength region. The FTIR spectrometer is used to identification of unknown materials and bond formation. The bond formation, imperfections, and impurities were observed by the PL spectrometer. Keithley spectrometer is used for I-V characteristics and calculates electrical resistivity by Ohms law.

A Jain, P K Sharma, S K Jain, Dashty T Akrawy and G Saxena, Decay properties of undetected superheavy nuclei with z > 110, Physica Scripta, 98/085304.
Q1, I. F. = 2.93, https://doi.org/10.1088/1402-4896/ace00d

Abstract
A comprehensive study of favoured and unfavoured α-decay, cluster decay, weak-decay along with spontaneous fission in undetected superheavy nuclei within the range for proton number 111 ≤ Z ≤118 and neutron number 161 ≤ N ≤192 is performed. Half-lives for various mentioned decays are estimated with good accuracy on the basis of NUBASE2020 and are found in excellent match with the known half-lives. α-decay mode is found most probable in this wide range and correspondingly potential α-decay chains are reckoned. Peculiarly, the chances of cluster emission, as well as weak-decay, are also anticipated in this region of the periodic chart which open new pathways of detection of superheavy nuclei.

Jagmohan Lal Sharma1, M.C. Mishra2, S.K. Jain3 and Balram Tripathi, Structural and optical characteristics of cudoped cds composite thin Films, Journal of Physics: Conference Series, 2663.
Q4, I. F. = 0.48, https://doi.org/10.1088/1742-6596/2663/1/012009

Abstract
In this paper spin-coating method is used to create copper doped CdS composite thin films on glass substrates. Prepared Cux (CdS)1-x composite thin films, where x=1, 3 and 5 wt% Cu doped, have been characterised using an X-ray Diffractometer (XRD), scanning electron microscope (SEM) and UV-Visible spectrometer. These measurements provide the structural, morphological and optical properties of both pure and Cu doped CdS. The XRD pattern was used to examine the crystal structure and grain size of the CdS thin film. The optical spectra show absorption and band gap values of prepared samples. The band gap values have been found between 2.41 to 1.71. The photoluminescence (PL) spect rum emitted a strong peak approximately 430 nm which shows better optical quality for many applications.

Dinesh Kumar Yadav, Anju Yadav, Sahil Singh, Ratan Singh Payal, Narendra Jakhar, S.K. Jain, Balram Tripathi, Study of bismuth oxide/polystyrene composites as flexible electrodes for super capacitors, Materials Today: Proceedings.
Q3, I. F. = 2.59, https://doi.org/10.1016/j.matpr.2023.02.327

Abstract
Efficient and high storage capacity composite electrodes are needed to store energy in flexible devices. We are reporting effect of filler concentration of bismuth oxide (Bi2O3) (Bi2O3 represented as BO = 1 to 5 wt%) on the charge storage performance of polystyrene (PS) composites. Bi2O3/PS composites fabricated via solution casting method, show homogenous distribution of bismuth oxide (Bi2O3) in the polystyrene matrix and attains high dielectric constant upto 5.39 at low frequency while stable dielectric constant upto 4.38 at high frequency attributes interfacial polarization occurred due to bismuth oxide distribution in the polystyrene matrix. The dielectric response indicates that Bi2O3/PS composites maybe thought of as flexible electrodes for high performance super capacitors.

Jain, K, Jain, S.K, Malhotra, A, Tripathi, B, Sahu, R, Influence of Multiwalled Carbon Nanotubes in Sulfur/Carbon Nanotube Composites Synthesized Using Solution Casting Method, Engineering 2023, Engineering Proceedings, MDPI, 59(1), 217.
Q3, https://doi.org/10.3390/engproc2023059217

Abstract
In this manuscript, we are reporting on the influence of MWNTs (multiwalled carbon nanotubes) on the structural, bonding, and surface morphological response on sulfur nanoparticles. Sulfur and multiwalled carbon nanotube (MWCNT) composites are formed using the solution casting method. The concentration of MWCNTs (0.01 and 0.05) and sulfur (0.99 and 0.95), respectively, was taken in weight ratios during fabrication of the composites. These fabricated composites have been characterized using XRD (X-ray diffraction), FESEM (field emission scanning electron microscopy), and FTIR (Fourier-transform infrared spectroscopy) techniques. XRD spectra reveal that the crystallite size distribution was in the range of ca. 55 nm to 78 nm, as well as enhanced crystallinity upon increasing the concentration of MWCNTs in sulfur composites. Dislocation density and strain have been found to be increased in composites showing increased augmentation of MWCNTs (i.e., S95% MWCNT5%), while FESEM images confirm the uniform distribution of MWCNTs in sulfur composites, along with round structures at the nanoscale range. FTIR spectra depicted the bending and stretching of C-H bands. Composites with a higher concentration of MWCNTs show slightly more stretching vibrations. This indicates the further delocalization of electrons, which reveals that as MWCNTs' concentration is increased, electrical conductivity enhances, showing that MWCNTs could perform better in electrical industries. The further delocalization of electrons also expresses that free electron–hole pair formation is better in composites with a higher concentration of MWCNTs, accounting for the fact that the photocatalytic response may increase in composites with a higher concentration of MWCNTs. Overall, it can be said that as the MWCNT concentration is ameliorated, the composites show a more crystallized structure with more vibrations. This characteristic of MWCNTs/sulfur composites is useful in photocatalytic response as well as in cathode materials in sulfur batteries.

Ankita Choudhury, Arka Dey, Chiranjib Ghosh, Avijit Dalal, Rajat Mahapatra, Saikat Biswas, Nilanjan Halder, Aniruddha Mondal, Positive temperature coefficient of resistance of Mg-GeO2 nanowire array film, Journal of Applied Physics, 133/ 045302.
Q2, I. F. = 3.2, https://doi.org/10.1063/5.0130729

Abstract

Here, glancing angle deposition is employed to synthesize the undoped GeO2 and Mg-doped (0.4 and 0.8 at. %) GeO2 nanowires (NWs) on a Si substrate. The microscopic images show the formation of the NW-like morphology of the grown materials. The gradual decrease in the average ratio of length to diameter depicts the worsening of the formation of NWs with the incorporation of Mg into the GeO2 host lattice. This also affects the crystallinity characteristics of the materials, which have been demonstrated from the selected area electron diffraction (SAED) pattern of the materials. The polycrystallinity nature of undoped GeO2 NWs changes to amorphous due to the introduction of Mg, which has been confirmed from both the obtained SAED and x-ray diffraction patterns of the samples. The presence of Mg was confirmed from the obtained broad bands at 473 and 437 cm−1 in the Fourier transmission spectrum of the doped samples. The increasing conductance with the temperature of Au/undoped GeO2 devices can be explained by the thermionic emission process, whereas the Mg-GeO2 device shows an overall decrease in conductance with increasing temperature. We have ascribed the origin of this abnormal conductance as the positive temperature coefficient of resistance, which is one of the first reports, due to the generation of random grain boundaries and enormous electron trapping at the Au/Mg-GeO2 NW junction. Furthermore, the undoped GeO2 NW device shows good temperature-dependent conductivity as well as stability compared to the doped one.

Prarbdh Bhatt; Tirthankar Moitra; Vipin Kumar; Kamakhya Prakash Misra; Saikat Chattopadhyay; Nilanjan Halder, Structural and optical characteristics of Nb-doped WS2/WO3 QDs, AIP Conf. Proc. 2752/ 050006.
https://doi.org/10.1063/5.0136062

Abstract

Tunable band gap in different nanostructure forms is an interesting feature of transition metal dichalcogenides (TMDCs) like WS2, WSe2, MoS2, and MoSe2 etc. We, herein, report the synthesis of Nb doped WS2/WO2 hybrid quantum dots (QDs) by a facile hydrothermal method followed by solution-based probe sonication and centrifugation. The structural characteristics, surface morphology and elemental composition of the hydrothermally synthesized powder samples were investigated. The UV-Vis absorbance spectra of Nb doped WS2/WO2 QDs suggested a red shift in the absorption edge with increased doping percentage.

Priyanka Kumari, Susruta Samanta, Kamakhya Prakash Misra, Anupam Sharma, Nilanjan Halder, Saikat Chattopadhyay, Optoelectronic properties of spherical ZnS nanoparticles synthesized by sol-gel method, 2723, 020014.
https://doi.org/10.1063/5.0139067

Abstract
ZnS nanoparticles were synthesized via low-cost Sol-Gel chemical method using Zinc acetate (Zn(CH3COO)2.2H2O) and Thiourea (NH2CSNH2) as precursors. To investigate the structural properties, the sample was characterized using X-Ray diffraction (XRD) technique. Major diffraction peaks like (111), (220) and (311) confirm the cubic structure of the sample. Debye–Scherrer (D–S) calculation shows that the size of the particles is around 8nm and Williamson–Hall (W–H) plot helps to understand the strain profile generated in the sample. FTIR study provides the information about functional groups present in ZnS nanoparticles and validates the presence of its characteristic peak at around 602cm-1. To understand the optical properties, UV-Vis spectroscopic analysis was performed in absorbance mode. It shows the absorption peak at 314nm which confirms a blue shift while compared with reported bulk ZnS. We believe the shift is due to the size miniaturization of the sample. Optical band gap was calculated using well accepted Tauc's plot method. Calculated value (3.30eV) indicates the wide band gap nature of ZnS. FESEM micrographs provides a detail information regarding size, shape, and nature of growth of our sample. It confirms the particles in the sample are spherical in nature with a tendency to agglomerate to make larger granular structure.

J. Tripathi, Yogesh Kumar, D. Kumar, S. Tripathi and A. Sharma, Curvature modulated structural and magnetic properties of CoO/Co thin films deposited onto 2-D nanosphere array, Journal of Magnetism and Magnetic Materials, 565/170179.
Q1, I. F. = 3.5, https://doi.org/10.1016/j.jmmm.2022.170179

Abstract
The importance and applications of nanoscale magnetic storage devices has been of current interest owing to the extensive research interest in magnetic nanocaps. Continuing their research trend, we have attempted to synthesize and characterize an important isolated magnetic nanocaps system constituting Co and its oxide. CoO/Co thin films were deposited onto self-assembled arrays of polystyrene (PS) nanospheres (~600 nm diameter) under ultra-high vacuum environment using electron beam evaporation technique. The magnetic and structural properties of these nanostructures were then compared with those of simultaneously deposited films on bare Si substrate (referred to as reference film). The studied film and the reference film were grown in polycrystalline manner as observed from X-ray diffraction measurements while their roughnesses as observed from X- ray reflectivity were quite different. X- ray reflectivity showed that for the reference films well defined Kiessig oscillations appeared suggesting low roughness in the deposited films, while the films on PS followed the curvature of underlying nanospheres and thus have very high roughness resulting in the disappearance of Kiessig oscillations. Magnetic measurements exhibited a drastically high coercivity when the substrate was changed from flat (Si) to curved one (PS). As the film thickness was increased, the coercivity first showed a slight decrement (4.92 kA/m) and beyond 40 nm film thickness, it showed some enhancement (14.2 kA/m). The exchange bias measurements also showed interesting results with variation in film thickness. Co 10 nm film deposited on PS showed negative exchange bias of −127 kA/m which decreased to −26 kA/m in 100 nm film. The overall results were explained by correlating the magnetic and microstructural properties of the thin films as a function of thickness.

A. Jain, A. Sharma, J. Singh, H. S. Dager and J. Tripathi, Study of Structural and Optical Properties of Zirconium Oxide Nanoparticles, Journal of Physics Conference Series, 2603, 012007.
Q4, https://iopscience.iop.org/article/10.1088/1742-6596/2603/1/012007

Abstract
In present study Zirconium dioxide (ZrO_2) nanoparticles (NPs) were synthesized by using the chemical method. For the synthesis of desired NPs, oleyl amine (OA) was used as a surfactant material. OA plays a crucial role in inhibiting the aggregation of ZrO_2 nanocrystals. Particle surface stabilisation is facilitated by it. The average crystallite size estimated from X-ray diffraction (XRD) using Scherrer equation, to be 6.15nm. UV-vis absorption spectra in the wavelength range of 200-900 nm were obtained; energy band gap obtained approximately 2.52 eV in as prepared ZrO_2 NPs. Using FT-IR, the functional group and band structure of ZrO_2 were studied.

RDK Misra, KP Misra, Process-structure-biofunctional paradigm in cellular structured implants: an overview and perspective on the synergy between additive manufacturing, bio-mechanical behaviour and biological functions, Artificial Cells, Nanomedicine, and Biotechnology, 51(1) 630-640.
Q1, I. F. = 5.8, https://doi.org/10.1080/21691401.2023.2278156

Abstract
The overview describes the synergy between biological sciences and cellular structures processed by additive manufacturing to elucidate the significance of cellular structured implants in eliminating stress shielding and in meeting the bio-mechanical property requirements of elastic modulus, impact resistance, and fatigue strength in conjunction with the biological functionality. The convergence of additive manufacturing, computer-aided design, and structure-property relationships is envisaged to provide the solution to the current day challenges in the biomedical arena. The traditional methods of fabrication of biomedical devices including casting and mechanical forming have limitations because of the mismatch in micro/microstructure, mechanical, and physical properties with the host site. Additive manufacturing of cellular structured alloys via electron beam melting and laser powder bed fusion has benefits of fabricating patient-specific design that is obtained from the computed tomography scan of the defect site. The discussion in the overview consists of two aspects – the first one describes the underlying reason that motivated 3D printing of implants from the perspective of minimising stress shielding together with the mechanical property requirements, where the mechanical properties of cellular structured implants depend on the cellular architecture and percentage cellular porosity. The second aspect focuses on the biological response of cellular structured devices.

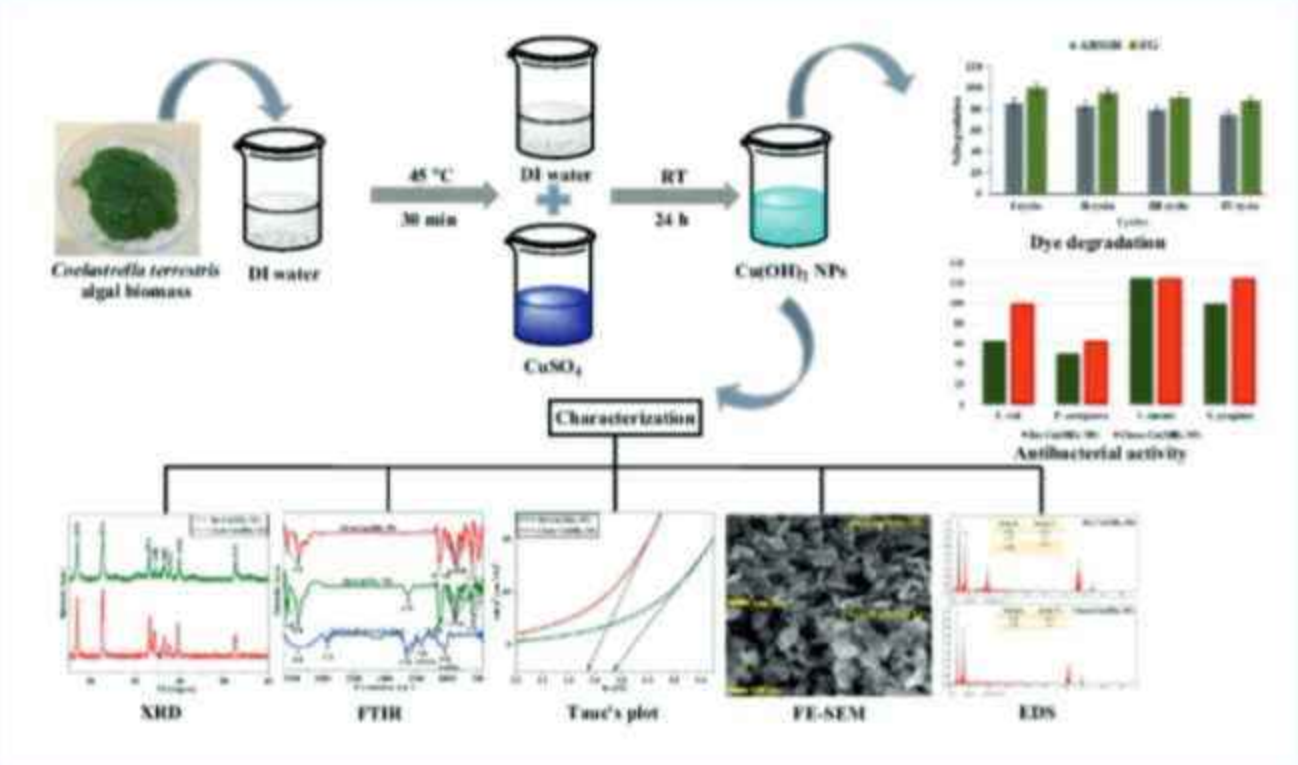
Ashok Kumawat, Saikat Chattopadhyay, Kamakhya Prakash Misra, Significant impact of co-doping Eu-doped ZnO nanoparticles with Li on structural–optical properties relationship, Materials Technology, 38(1) 2253646.
Q2, I. F. = 3.1, https://doi.org/10.1080/10667857.2023.2253646

Abstract
We describe here the structural evolution and optical properties of co-doping of Eu-doped ZnO nanoparticles with lithium synthesized by the sol-gel process. The characterization was carried out via X-ray diffraction (XRD), Fourier transmission infrared (FTIR), UV-Vis spectroscopy, and photoluminescence (PL) techniques. XRD confirmed hexagonal wurtzite phase of ZnO nanoparticles with crystallite size in the range of 22–61nm. The band gap calculated from UV-vis spectra was in the range of 3.30–3.26eV for undoped and Li and Eu co-doped ZnO nanoparticles, respectively, while photoluminescence study indicated that Li in Eu-ZnO affected the PL emission intensity, which was attributed to defects present in the crystal lattice. The field emission scanning electron microscopy (FESEM) images revealed the diverse morphology containing spherical, tri-, tetra-, penta- and hexagonal rod-like nanostructures.

Manisha Khandelwal, Sunita Choudhary, Harish, Ashok Kumawat, Kamakhya Prakash Misra, Devendra Singh Rathore, Rama Kanwar Khangarot, Superior photocatalytic degradation of water pollutant dyes and strong antimicrobial activity in Coelastrella terrestris algal-mediated biosynthesized stable copper hydroxide nanoparticles, Biomass Conv. Bioref.
Q2, I. F. = 4, https://doi.org/10.1007/s13399-023-05118-4

Abstract

Given the detrimental impact of excessive and improper usage of dangerous chemical compounds on environmental pollution, it is imperative to explore facile and eco-friendly methods for the synthesis of nanoparticles (NPs). In this regard, a novel green synthetic protocol was adopted for the synthesis of copper hydroxide nanoparticles ($Cu(OH)_2$ NPs), using *Coelastrella terrestris* algal extract. The biosynthesized and chemically synthesized $Cu(OH)_2$ NPs were systematically characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), UV-visible (UV-Vis), and field emission scanning electron microscopy (FE-SEM) coupled with energy-dispersive spectroscopy (EDS). The XRD confirmed the formation of an orthorhombic phase of $Cu(OH)_2$ NPs and revealed that the crystallite size of biosynthesized $Cu(OH)_2$ NPs (Bio-$Cu(OH)_2$ NPs) and chemically synthesized $Cu(OH)_2$ NPs (Chem-$Cu(OH)_2$ NPs) were 29.32 nm and 24.69 nm, respectively, corresponding to the major crystallographic plane (021). The synthesized $Cu(OH)_2$ NPs were utilized efficiently for important applications, such as photocatalytic and antimicrobial activities. Bio-$Cu(OH)_2$ NPs demonstrated exceptional photocatalytic activity, achieving degradation efficiencies of 85.67% for Amido black 10B (AB10B) and 98.87% for Fast green (FG) dyes, respectively. They also exhibited potent antibacterial activity against a multidrug-resistant *Pseudomonas aeruginosa* bacterial strain with a 50 µg/mL MIC value and superior antifungal activity against *Candida albicans* fungal strain with a 250 µg/mL MIC value. These findings highlight the potential of algal-mediated $Cu(OH)_2$ NPs as versatile agents for wastewater treatment and antimicrobial applications. Our work underscores the importance of green synthesis methods and the promising future of these nanoparticles in addressing environmental and health challenges.



Shachi Pachauri, Jyoti Malik, Kamakhya Prakash Misra, Shiva Shakti Singh, Numerical study of instabilities in magnetized inhomogeneous collisional dusty plasmas under dust dynamics, Magnetohydrodynamics, 59 (2) 187-200.
Q3, I. F. = 0.9, DOI: 10.22364/mhd.59.2.5

Abstract
This article describes a numerical investigation of the behaviour of streaming instabilities in a magnetized, inhomogeneous, and collisional dusty plasma with typical plasma parameters when plasma properties are influenced by dust dynamics. Basic fluid equations have been formulated, including the dynamics of negatively charged dust particles along with the recombination effect on the surface of charged dust particles. The effect of dust-neutral collision has also been taken into consideration in the considered plasma model. A magnetic field of static intensity is applied at an arbitrary propagation angle. A normal mode analysis method has been used to derive dispersion relations of the existing instabilities, which are solved numerically using MATLAB. Two instabilities have been investigated, whose profiles of phase velocities and the normalized growth rates with respect to different plasma parameters like the magnetic field strength, recombination rate, electrostatic potential, dust charge and density of neutral were observed and interesting findings are noted.

Sarika Singh, Kamakhya Prakash Misra, Alveera Sohel, Rama Sharma, UV Suppression in photoluminescence emission and improved photocatalytic activity under sunlight in nanoassemblies and nanocrystals of ZnO, Physica Scripta, 98 (5) 055906.
Q1, I. F. = 2.9, DOI: 10.1088/1402-4896/acc764

Abstract
The objective of present study is to analyse the impact of alterations in the shape and size of ZnO on PL emission and photocatalytic activity of ZnO nanostructures. The study also aims at addressing the knowledge gap between synthesis approach and its role in governing the optical, morphological and photocatalytic behaviour. Here, we report the facile and controlled synthesis of nanoassemblies (NA) and nanocrystals (NC) of ZnO via soft chemical approach. The synthesized ZnO nanostructures were characterized using TEM, SEM, UV–vis and photoluminescence (PL) measurement. The morphology of ZnO is tuned by adjusting the molar ratio of DEG and water whose impact is also noticed on the PL emission spectra. PL analysis revealed that the UV emission (378 nm) and defect levels attributed to Zn interstitial (Zn_i) and oxygen interstitial (O_i) are stabilized at ambient condition. However, UV band gap emission peak is significantly reduced making it lesser distinct by introducing appropriate amount of water in diethylene glycol (DEG) solvent during ZnO synthesis. Such controlled nanostructured growth demonstrates potential for sustainable photocatalytic activity under both UV and Sunlight irradiation. The study shows 100% photodegradation efficiency for ZnO NA and it get completely irradiated methylene blue dye within 90 min under UV light, whereas only 70% dye is degraded in 100 min for ZnO NC. Under natural Sunlight, ZnO NA has been achieved 97% degradation efficacy in 75 min; however, ZnO NC has degraded only 89% of dye. Further, the degradation of dye over ZnO was observed to follow pseudo first order reaction kinetic model that is used to determine the rate constant of the reaction.

AJ Maldonado, KP Misra, RDK Misra, Grain boundary segregation in a high entropy alloy, Materials technology, 38(1) 2221959.
Q2, I. F. = 3.1, https://doi.org/10.1080/10667857.2023.2221959

Abstract

Grain boundary (GB) segregation was experimentally studied in a bulk high entropy Cantor alloy, which indicated for the first time that Cr strongly segregates to the GBs along with the weak segregation of Mn, implying co-segregation of Cr and Mn to the GBs. The strong segregation of Cr and weak segregation of Mn are explained in terms of the driving forces for GB segregation, where alloy interaction is favourable and stronger in the case of Cr, while elastic strain energy governs Mn segregation

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Manisha Khandelwal, Sunita Choudhary, Ashok Kumawat, Kamakhya Prakash Misra, Devendra Singh Rathore, Rama Kanwar Khangarot, Asterarcys quadricellulare algae-mediated copper oxide nanoparticles as a robust and recyclable catalyst for the degradation of noxious dyes from wastewater, RSC Advances, 13, 28179-28196.
Q1, I. F. = 3.9, DOI: 10.1039/D3RA05254K

Abstract

The present article explores the synthesis of copper oxide nanoparticles (CuO NPs) utilizing *Asterarcys quadricellulare* algal extract and examines the effect of various reaction parameters on the size and morphology of the nanoparticles. The samples were thoroughly characterized using XRD, FTIR, UV-vis, FE-SEM, and EDS techniques. The XRD analysis disclosed that the size of the synthesized nanoparticles could be controlled by adjusting the reaction parameters, ranging from 4.76 nm to 13.70 nm along the highest intensity plane (111). FTIR spectroscopy provided evidence that the phytochemicals are present in the algal extract. We have compared the photocatalytic activity of biologically and chemically synthesized CuO NPs and observed that biologically synthesized CuO NPs showed better photocatalytic activity than chemically synthesized CuO NPs. The biosynthesized CuO NPs (S8) demonstrated outstanding photodegradation activity towards four different organic dyes, namely BBY, BG, EBT, and MG, with degradation percentages of 95.78%, 98.02%, 94.15%, and 96.04%, respectively. The maximum degradation efficacy of 98.02% was observed for the BG dye at optimized reaction conditions and 60 min of visible light exposure. The kinetics of the photodegradation reaction followed the pseudo-first-order kinetic model, and the rate constant (k) was calculated using the Langmuir–Hinshelwood model for each dye. This study provides an efficient and sustainable approach for synthesizing CuO NPs with superior photocatalytic degradation efficiency towards organic dyes.

P. Kumari, K P Misra, S Samanta, S Chattopadhyay, Photoluminescence, morphology and band gap in Europium-doped ZnS nanoparticles, Materials Technology: Advanced Performance Materials, 39/2286822 (1-10).
Q2, I. F. = 3.1, https://doi.org/10.1080/10667857.2023.2286822

Abstract

Current study aims at synthesising Eu-doped ZnS nanoparticles by sol-gel co-precipitation and then characterising them for their structural, optical, and morphological features. Eu-doped ZnS NPs with doping levels of 1, 3, 5, and 7 at.% were synthesised. The characterisation tools such as XRD, UV-Vis, FTIR, photoluminescence and FESEM were employed to analyse their properties. Zinc blend phase with particle sizes lying in the range of 5.0 to 7.2 nm was confirmed by XRD. Eu-doped ZnS NPs show a band gap decrement at a higher level of doping. Defects induced UV and visible emission peaks were observed in photoluminescence emission spectra. Random-shaped particle-like structures that effectively have a persistent enlargement of size were seen in FESEM. The particle size was seen to monitor the band gap at higher doping levels. Eu doping was found to promote the growth of particle sizes which eventually resulted in decrement of the band gap.

Anusha, P. Kumari, A. Ani, P Poornesh, S. Chattopadhyay, V.C.Petwal, V. P. Verma, J. Dwivedi, Methodical tuning of NH3 gas sensing in WO3 thin films by electron beam irradiation, Journal of Materials Science: Materials in Electronics, 35/318
Q2, I. F. = 2.8, https://doi.org/10.1007/s10854-024-12065-x

Abstract

The present work focuses on the structure, morphology, optical and sensing analysis of Electron Beam Irradiation (EBI) treated WO_3 films synthesized by the spray pyrolysis technique. X-ray diffraction (XRD) revealed a slight shift in the 2θ position, indicating stress generated due to EBI process. Scanning Electron Microscopy (SEM) morphographs presented well-defined grains at higher irradiation dosages. X-ray Photoelectron Spectroscopy (XPS) studies showed increased oxygen vacancy defects for the 5 kGy treated sample compared to unirradiated WO_3. Sensing analysis of unirradiated and EBI-treated films was conducted towards ammonia (NH_3) at an optimum operating temperature of 200 °C. Sensor response of 5 kGy treated film increased by ~ 4.5 fold compared to unirradiated film at 5 ppm NH_3 concentration. The current study demonstrates the importance of EBI in tailoring the NH_3 sensing properties of WO_3 films.

Aninamol Ani, P. Poornesh, Albin Antony, Saikat Chattopadhyay, Synergism of spray-pyrolyzed aliovalent Ga (iii) ions and ZnO nanostructures for selective sensing of hazardous CO gas towards low ppm levels, Sensors and Actuators B: Chemical, 399/134827
Q1, I. F. = 8.4, https://doi.org/10.1016/j.snb.2023.134827

Abstract

Ga-doped ZnO (GZO) nanostructures deposited via low-cost spray pyrolysis process are employed in this study to identify low quantities of carbon monoxide gas. XRD studies reveal the single-phase wurtzite structure of ZnO thin films, thereby confirming the structural stability post-Ga doping. Raman examination discloses the vibrational characteristics and provides some early insights into the existence of defects in the films. The nanograins having well-defined grain boundaries noticed from the inspection of SEM images participate in the gas sensing performance as the site for the active adsorption of CO molecules. The defects, mainly oxygen vacancies responsible for the enhancement in the CO sensing characteristics were confirmed from room temperature photoluminescence (RTPL) spectra and XPS analysis. The CO sensing measurements reveal that 15 wt% GZO exhibited the highest sensing performance of 0.08 towards 1 ppm and 0.41 towards 5 ppm. GZO thin films had response and recovery times that were both extraordinarily quick under 40 s.

N. P. Madhukar, K. Gurukrishna, Bhoomika R. Bhat, U. Deepika Shanubhogue, Suraj Mangavati, Ashok Rao & Saikat Chattopadhyay, Role of sintering temperature in modulating the charge transport of BiCuSeO thermoelectric system: correlations to the microstructure, Applied Physics A: Materials Science And Processing, 130/55.
Q2, I. F. = 2.7, https://doi.org/10.1007/s00339-023-07218-4

Abstract

The influence of sintering temperature on the thermoelectric (TE) transport of BiCuSeO is reported in the present work, with an aim to optimize the processing conditions for higher TE transport. BiCuSeO samples were synthesized at four different sintering temperatures, viz., 673 K, 773 K, 873 K, and 973 K. A non-degenerate type of conductivity is observed in all the samples at high temperatures, witnessing the thermal activation of the carriers. The Fermi level was positioned below the valence band maximum, thereby exhibiting a p-type degenerate transport in the entire range of temperature. It was observed that the variations of weighted mobility and power factor were found to have identical trends. The highest power factor was noticed at 554 K with a value of 129 $\mu Wm^{-1} K^{-2}$ for the sample sintered at 673 K.

B.S. Srujana, Adithya Prakash, Saikat Chattopadhyay, Mahesha M.G., Zirconium doped zinc oxide thin films grown by spray pyrolysis technique for TCO applications, Materials Today Communications, 37/107476.
Q2, I. F. = 3.8, https://doi.org/10.1016/j.mtcomm.2023.107476

Abstract

Zirconium (Zr) doped Zinc Oxide (ZnO) thin films were grown on pre-cleaned glass substrates by spray pyrolysis technique. The dopant was added in different concentrations to study its influence on the structural, optical, morphological, and electrical properties of ZnO thin films. X- Ray Diffractogram (XRD) data was used to study the structural properties of all the thin films. It was found that the crystallite size varied between 25 and 45 nm for dopant at different concentrations. Additionally, it was discovered that ZnO possessed a hexagonal wurtzite structure with (002) as its preferred orientation regardless of the doping doses. The optical properties for all the thin films were obtained by analysing the absorption spectra. The transmittance of all the thin films ranged between 65 % and 86 % in the visible range with 4 at % Zr doped ZnO having highest transmittance. Scanning Electron Microscopy (SEM) results showed the agglomeration of particles at higher concentrations of the dopant. Electrical studies showed that the resistivity of the doped samples decreased as compared to the pristine sample. Sample with 6 % of doping had the highest carrier concentration and hence, showed the least resistivity of 67 Ω cm.

VK Sharma, AK Kumawat, SS Rathore, I Sulania, RC Meena, SK Kedia, Rashi Nathawat, The SHI irradiation induced transition to negative dielectric constant phase in K2Bi4Ti4WO18, Frontiers in Physics, 11, 1127118.
Q1, I. F. = 3.8, https://doi.org/10.3389/fphy.2023.1127118

Abstract

In present communication, a new Aurivillius family compound $K_2Bi_4Ti_4WO_{18}$ was synthesized, and the impact of swift heavy ion (SHI), Ni^{11} irradiation on its surface and dielectric properties has been studied in detail. The phase formation in this complex oxide, and crystallization to *B2cb* symmetry was confirmed by the X-ray diffraction. However, post irradiation the XRD, SEM and AFM studies shows the surface amorphization, in agreement with the theoretical calculations. Furthermore, the effect of irradiation was also observed in the bulk dielectric properties as the system transform to a phase with negative dielectric constant above 350 K in the radio frequencies. This transition is in correlation with significant change in other dielectric parameters such enhancement in AC conductivity, a helical Nyquist plot and multiple dielectric relaxations. This conspicuous changes in the dielectric response post irradiation is attributed to the SHI induced defect formation, modification of energy barriers and their consequences on the electronic structure. Thus, current study suggests that the dielectric properties of Aurivillius $K_2Bi_4Ti_4WO_{18}$ could be tailored by ion irradiation and opens a new possibility of tuning functional properties.

UA Kumar, GM Singh, A Kumar, R Nathawat, Taguchi design of experiments-based optimization and experimental investigation of mechanical performance of hybrid epoxy nanocomposites, Materials Protection, 64 (4), 433-443.
Q2, I. F. = 4.7, DOI: 10.5937/zasmat2304433U

Abstract

The growing demand for safety in the aerospace and automotive industries continuously motivates researchers to develop high-strength lightweight hybrid polymer composites, which typically consist of a combination of carbon nanotubes (CNTs) and ceramic nanoparticles in an epoxy matrix. However, the development of such composites is usually hindered by some existing challenges, such as the optimization of the concentration of CNTs, nanoparticles and their distribution in viscous epoxy matrices. To make the most of the impressive mechanical properties of CNTs and SiO2 nanoparticles, an ultrasonic dual mixing (UDM) technique was used to develop hybrid epoxy nanocomposites (HENCs) based on MVCNTs/SiO2. A well-known approach, such as the Taguchi design of experiment, was used to optimize the concentration of MVCNTs, SiO2 nanoparticles in the epoxy, and the curing cycle of the epoxy in relation to the tensile strength of the resulting HENCs. Additionally, tensile strength, Young's modulus, strain to failure and hardness were measured for HENC. The results revealed that the optimum concentration of 1% MVCNT and 10% SiO2 leads to the maximum increase in tensile strength and other mechanical properties of HENC.

AK Kumawat, SS Rathore, S Singh, R Nathawat, Structural transition, and photoluminescence behavior of (V2O5) 1-x (Ag0. 33V2O5) x (x= 0 to 0.1) nanocomposites, Results in Chemistry, 5, 100802.
Q3, I. F. = 2.8, https://doi.org/10.1016/j.rechem.2023.100802

Abstract

The two phase $(V_2O_5)_{1-x}(Ag_{0.33}V_2O_5)_x$ (x = 0, 0.05, 0.075 and 0.1) nanocomposites were synthesized through one step hydrothermal process. The X-ray diffraction followed by two phase Rietveld refinement confirms the crystallization of V_2O_5 and $Ag_{0.33}V_2O_5$ phases in the *Pmmn* (orthorhombic) and C2, (monoclinic) symmetry respectively without any impurity phase. Furthermore, the FE-SEM, EDX, PL, UV–vis and XPS characterization were carried out for microstructural, optical and chemical studies. The formation of $Ag_{0.33}V_2O_5$ nano-belts with average length and width of 3–4 μm and 40–50 nm respectively, were observed in the electron micrograph. Moreover, the XPS study confirms the constituent element are in expected oxidation states with Vanadium in only + 5 (V^{+5}) for V_2O_5 and in mixed states (V^{+5} and V^{+4}) for 10 % $Ag_{0.33}V_2O_5$ nanocomposite. The photoluminescence spectra of these nanocomposite depicts two broad emission peaks located around 570 nm and 707 nm due to indirect inter-band and mid-state energy states transitions, respectively. PL also prove the increase in oxygen vacancies by loading of Ag in V_2O_5 matrix. The optical absorption of $Ag_{0.33}V_2O_5$ represents a decrease in the energy band gap (2.10–1.97 eV) by adding Ag concentration in the V_2O_5, which also proved the semiconductor to metal transition (SMT).

Ashish K. Kumawat, Kriti Kumari, Bhakti Tripathi, Satyapal Rathore and Rashi Nathawat, Synergistic Properties of (Au2V)0.01(V2O5) 0.99 Composite: Synthesis, Characterization, and Enhanced Functionalities, Nano World Journal, 9(S5): S231-S235.
Q4, I. F. = 1.5, DOI: 10.17756/nwj.2023-s5-045

Abstract

The synergistic combination of distinct materials to create composite structures has garnered significant interest in various scientific disciplines. In this study, we present the synthesis and characterization of a composite material composed ofAu2V (Gold vanadate) and V2O5 (Vanadium pentoxide). The unique properties ofV2O5, including its semiconducting behavior. The integration of Au2V with V2O5offers the potential to create a composite material. The synthesis methodology, involving the controlled formation is detailed. Comprehensive characterization through techniques X-ray diffraction (XRD), Field emission-scanning electron microscopy (FE-SEM), Fourier-transform infrared spectroscopy (FTIR), Ultraviolet-Visible spectroscopy (UV-Vis) and Photoluminescence spectroscopy (PL) have been performed. This study contributes to the understanding of composite materials. The (Au2V)0.01(V2O5)0.99 composite's tailored properties and improved catalytic activity hold promise for future applications in green and sustainable catalysis, paving the way for innovative solutions in diverse chemical processes.

S. Chakraborty, H.P. Sharma a, S.S. Tiwary et. al., Incipient reflection asymmetry in 127Xe, Nuclear Physics A, 1037-122706.
Q2, I. F. = 1.4, https://doi.org/10.1016/j.nuclphysa.2023.122706

Abstract

Excited states in ^{126,127,128}Xe were populated via ^{122}Sn(^{9}Be, xnγ) fusion-evaporation reaction at a beam energy of 48 MeV. A positive parity rotational-like sequence of Δ=2-transitions, which is found to decay into the negative parity band via *E*1 transitions, is observed above =19/2+ state at 2307 keV in ^{127}Xe. Such enhanced *E*1 γ-transitions are also observed between the antimagnetic rotational (AMR) and longitudinal wobbling (LW) bands in this nucleus. These indicate the presence of simplex symmetry with s = ± excitation in ^{127}Xe

S. Chakraborty, H.P. Sharma a, S.S. Tiwary et. al. Three-quasineutron 3-band in 127Xe, Journal of Physics G: Nuclear and Particle Physics, 50 -075106.
Q1, I. F. = 3.5, DOI: 10.1088/1361-6471/acd86a

Abstract

Structures of negative parity multi-quasiparticle states in ^{127}Xe have been investigated through in-beam γ-ray spectroscopy. Excited states were populated via the ^{122}Sn(^{9}Be, 4nγ)^{127}Xe fusion-evaporation reaction at E_{beam} = 48 MeV. Two new negative parity bands have been identified and their structures have been discussed using the triaxial projected shell model (TPSM) approach. One of the bands is established above the Iπ = 27/2$^-$ state at 3702 keV and based on the experimental inferences and TPSM results, this band is interpreted as a γ-band built on a three-quasineutron configuration. The second sequence, found above Iπ = 31/2$^-$ state at 4848 keV, is proposed to have a two-proton aligned configuration ($\nu h11/2 \otimes \pi h11/22$), considering the properties of this band with the neighbouring isotopes. The analysis of the TPSM wave function substantiates the proposed interpretation of this band.

Mukherjee, A., Bhattacharya, S., Trivedi, Tiwary, S. S. et. al. Evidence of transverse wobbling motion in Eu 151, Physical Review C, 107(5), 054310.
Q1, I. F. = 3.1, DOI: 10.1103/PhysRevC.107.054310

Abstract

Transverse wobbling was investigated in the 151Eu nucleus by populating the excited states using 148Nd(7Li, 4n)151Eu at a beam energy of 30 MeV. Three new interconnecting transitions have been placed between the two negative parity bands. The *M1/E2* character of the interconnecting Δ=1 transitions between the negative parity bands was extracted from the mixing ratios using the DCO and linear polarization method. The spin and parity of the states of different bands have also been assigned. The dominant *E2* character of the interlinking transitions between the yrast and first phonon wobbling band and the dominant *M1* character between the yrast band and its signature partner band indicate the presence of transverse wobbling in the 151Eu nucleus. It is further demonstrated that the triaxial projected shell model approach describes the observed experimental properties.

S. I. Mukhin, A. Mukherjee and S. S. Seidov, Correspondence between Dicke-model semiclassical dynamics in the superradiant dipolar phase and the Euler heavy top, Physical Review A, 107, 023721.
Q2, I. F. = 2.97, DOI: 10.1103/PhysRevA.107.023721

Abstract

Analytic expression is found for the frequency dependence of the transmission coefficient of a transmission line inductively coupled to the microwave cavity with the superradiant condensate. Sharp transmission drops reflect the condensate's frequencies spectrum. These results pave the way to direct detection of emergence of the superradiant condensates in quantum metamaterials. Results are based on the analytic solutions of the nonlinear semiclassical dynamics of the superradiant photonic condensate in the Dicke model of an ensemble of two-level atoms dipolar coupled to the electromagnetic field in the microwave cavity. In the adiabatic limit with respect to the photon degree of freedom, the system is approximately integrable with evolution being expressed via Jacobi elliptic functions of real time. Depending on the coupling strength, the semiclassical coordinate of the superradiant condensate in the ground state either oscillates in one of the two degenerate minima of the condensate's potential energy or traverses between them over the saddle point. An experimental setup for measuring of the breakdown of the normal phase of the Dicke model via coupling to the transmission line is proposed. A one-to-one mapping of the semiclassical motion of the superradiant condensate on the nodding of unstable Lagrange "sleeping top" also turns the Dicke model into an analog device for modeling the dynamics of mechanical systems.

S. I. Mukhin, A. Mukherjee and S. S. Seidov, Correspondence between Dicke-model semiclassical dynamics in the superradiant dipolar phase and the Euler heavy top, Physical Review A, 107, 023721.
Q2, I. F. = 2.97, DOI: 10.1103/PhysRevA.107.023721

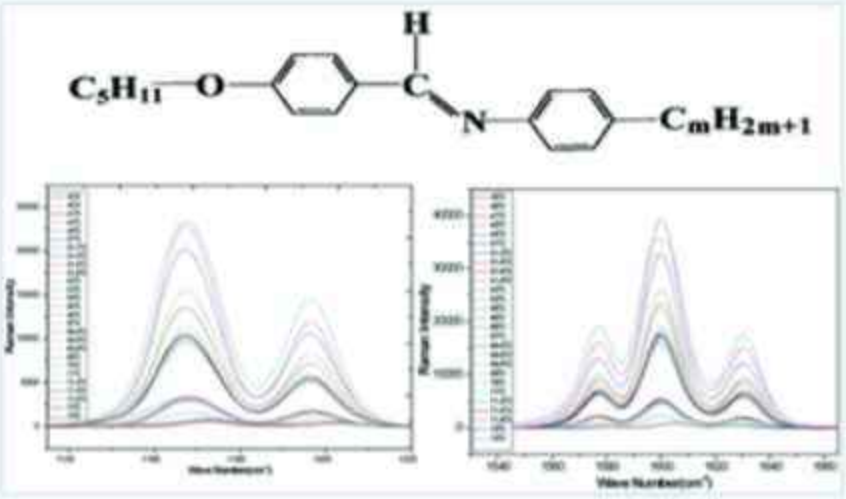
Abstract

Analytic expression is found for the frequency dependence of the transmission coefficient of a transmission line inductively coupled to the microwave cavity with the superradiant condensate. Sharp transmission drops reflect the condensate's frequencies spectrum. These results pave the way to direct detection of emergence of the superradiant condensates in quantum metamaterials. Results are based on the analytic solutions of the nonlinear semiclassical dynamics of the superradiant photonic condensate in the Dicke model of an ensemble of two-level atoms dipolar coupled to the electromagnetic field in the microwave cavity. In the adiabatic limit with respect to the photon degree of freedom, the system is approximately integrable with evolution being expressed via Jacobi elliptic functions of real time. Depending on the coupling strength, the semiclassical coordinate of the superradiant condensate in the ground state either oscillates in one of the two degenerate minima of the condensate's potential energy or traverses between them over the saddle point. An experimental setup for measuring of the breakdown of the normal phase of the Dicke model via coupling to the transmission line is proposed. A one-to-one mapping of the semiclassical motion of the superradiant condensate on the nodding of unstable Lagrange "sleeping top" also turns the Dicke model into an analog device for modeling the dynamics of mechanical systems.

Bhattacharjee, Debanjan, Alapati, P. R., & Bhattacharjee, A, Comparative studies of DFT and experimental Raman spectra of pure 5O.14 liquid crystalline compound, Liquid Crystals, 50(11–12), 1883–1892.
Q2, I. F. = 2.2, https://doi.org/10.1080/02678292.2023.2221653

Abstract

This article studies the density functional theory (DFT) and experimentally measured Raman spectrum of 5O.14 monomeric liquid crystalline compound. Raman spectroscopy in liquid crystal (LC) is very sensitive to temperature and with the variation of temperature every bond in the molecule shows different Raman peaks. Some important changes in the peaks were also noticed in different phases with the change in temperature. These changes occurred basically due to the changes in the molecular orientation with varying temperature. The structural and dynamics changes of the LC undergoing phase transitions have been analysed from the investigations of peak positions and linewidths. Finally, the results obtained from experimental and DFT generated Raman spectra confirm some interesting features to understand the behaviours of 5O.14 LC.



Chakraborty A, Bhattacharjee A, Bhattacharjee Debanjan, Quantum Mechanical Density Functional Approach for the Studies of Nonlinear Optical and Reactivity Parameter of 5O.5 Liquid Crystal. NanoWorld J, 9(S5): S227-S230.
Q4, DOI: 10.17756/nwj.2023-s5-044

Abstract
This article emphasizes the nonlinear optical properties of 5O.5 liquid crystal compound. Generally, 5O.5 is a Schiff based compound and it shows different liquid crystalline phases with the variation of temperature. With changing temperature, the phases of the liquid crystal changes and it gives various important information about the ordering of the liquid crystal. The density functional theory (DFT) approach has been used to find the different parameters such as reactivity parameters and structural parameters of the compound. Dipole moments, polarizability and non-linear optical (NLO) properties are essential to understanding different optical and physical behaviors of the liquid crystal are also reported in this article. The NLO properties of the compounds possess many properties which is useful for NLO based applications.

Lalit Kumar Sahoo, Dipali Basak, Ashok Kumar Mondal, Biswarup Satpati, Suraj Kumar Karan, Chinmay Basu, The preparation of LiF target for reactions involving 7Li target Vacuum, 212/112055.
Q1, https://doi.org/10.1016/j.vacuum.2023.112055

Abstract
The preparation of LiF targets on a self-supporting Ag backing (LiF/Ag) was discussed in detail using the vacuum evaporation process. The fabricated LiF targets were analyzed and efficiently characterized, with the target thickness measured by the energy loss of alpha particles through the target. The estimated thickness of LiF was ~0.63±0.09μm. The non-uniformity of the targets was thoroughly checked with the help of a collimator, and the non-uniformity was within 6.50 %. The surface morphology and elemental composition were investigated using transmission electron microscope (TEM) and the Energy dispersive X-ray spectroscopy (EDX). Further x-ray photoelectron spectroscopy (XPS) was performed on the prepared targets and the presence of LiF phase has been confirmed by XPS. The targets were used to study the ^{7}Li(p,n) reaction at the FRENA facility in Kolkata.

Ashish Kumar, G. Anil Kumar, Modification of lignin properties using alpha particles and gamma-rays for diverse applications, Radiation Physics and Chemistry, 202/110562.
Q2, I. F. = 2.776, https://doi.org/10.1016/j.radphyschem.2022.110562

Abstract
The irradiation of lignocellulosic biomass using high-energy radiations provides an economical green alternative method over chemical methods for the pretreatment of biomass before its use for applications like the production of biofuels, new sustainable materials, and filler for polymer composites. Thus, irradiation of lignin using high-energy ionizing radiations has potential use in lignin-based biorefineries and bio-polymer industries. In the present work, the kraft lignin was subjected to gamma-rays (1.17 and 1.33 MeV) up to a dose of 200 kGy, and alpha radiations (5.2 MeV) up to a dose of 1200 mGy. The irradiation produces free radicals in the irradiated material, triggering chemical reactions and changing the lignin's physicochemical properties. The chemical and structural changes in the irradiated lignin with different radiation doses were analyzed with various characterization techniques such as FTIR, XRD, DSC, and TGA. The results showed that gamma-rays significantly affected the amorphous regions of lignin samples compared to their crystalline regions. In contrast, alpha particles irradiation of lignin remarkably affected the crystalline structural morphology compared to the amorphous phase. The effect of gamma-rays irradiation on amorphous regions of lignin was more pronounced at low irradiation doses than at high doses. The impact of alpha particles irradiation on the physicochemical properties of lignin was studied and reported for the first time. The present work helps to choose the appropriate type of nuclear radiation for the pretreatment process as per the applications.

Sathi Sharma, Characterization study of NaI(Tl) γ-summing spectrometer, JINST, 18, P12014.
Q2, I. F. = 1.3, DOI: 10.1088/1748-0221/18/12/P12014

Abstract

The accurate information regarding the β-decay half-life, feeding pattern from the neutron-rich nuclei have utmost importance in the field of nuclear waste management from the fission reactors as well as correct understanding about the r-process nucleosynthesis in stellar sites. The low capture cross-section measurements are also considered as major task by experimental nuclear astrophysicists. These kinds of measurements are really difficult with conventional high-resolution gamma spectroscopy techniques due to less efficiency of the detectors. For this purpose, we have an almost 4π γ-summing NaI(Tl) spectrometer at SINP, Kolkata. It is basically a cylindrical shaped detector with six sectors of NaI(Tl) crystals read by 6 photomultiplier tubes (PMT) at one end. The detailed characterization of the spectrometer via experiment using laboratory standard sources and GEANT4 simulation model to interpret all the interesting properties will be presented here in this paper.

Sathi Sharma, Characterization study of NaI(Tl) γ-summing spectrometer, JINST, 18, P12014.
Q2, I. F. = 1.3, DOI: 10.1088/1748-0221/18/12/P12014

Abstract

The accurate information regarding the β-decay half-life, feeding pattern from the neutron-rich nuclei have utmost importance in the field of nuclear waste management from the fission reactors as well as correct understanding about the r-process nucleosynthesis in stellar sites. The low capture cross-section measurements are also considered as major task by experimental nuclear astrophysicists. These kinds of measurements are really difficult with conventional high-resolution gamma spectroscopy techniques due to less efficiency of the detectors. For this purpose, we have an almost 4π γ-summing NaI(Tl) spectrometer at SINP, Kolkata. It is basically a cylindrical shaped detector with six sectors of NaI(Tl) crystals read by 6 photomultiplier tubes (PMT) at one end. The detailed characterization of the spectrometer via experiment using laboratory standard sources and GEANT4 simulation model to interpret all the interesting properties will be presented here in this paper.

Arkabrata Gupta, Sathi Sharma, Sangeeta Das, Anik Adhikari, Anubhab Mondal, Madhusree Roy Chowdhury, Chandan D Bagdia, Lokesh Tribedi, Vandana Nanal, Abhijit Bisoi, M. Saha Sarkar, S. Sarkar, Lifetime measurement of the E = 2485.3 keV level of 25Al populated through 24Mg25Al resonance reaction, Nucl. Phys. A, 1042, 122806.
Q2, I. F. = 1.4, https://doi.org/10.1016/j.nuclphysa.2023.122806

Abstract

Results of our experimental study of the ^{24}Mg(ρ,)25Al resonance reaction at E=223 keV are presented. The proton beam energy is varied from 220 to 265 keV. An evaporated Mg target with thick Ta backing is used. We remeasure a mean lifetime of =6.04−2.65+3.03 fs for the E=2485.3 keV level of ^{25}Al, using Doppler shift attenuation (DSA) method. Three most successfully used empirical effective interactions developed for the sd shell by Wildenthal (w), Chung-Wildenthal (cw) and Preedom-Wildenthal (pw), are utilized to calculate energy spectra, spectroscopic factors, beta decay properties, transition probabilities and the lifetime of the resonance state in ^{25}Al within the framework of nuclear shell model. The theoretical results agree reasonably well with the experimental data. However, a detailed study for each set to identify the most preferred interaction for this nucleus is performed. Calculated lifetimes using two of the interactions (w, cw) agree better with the central value of the experimental lifetime of the resonance state measured in the present work

Book Chapters Published in 2023

P. Priya, N. Nirmala, S. S. Dawn, Kanchan Soni, Bagaria Ashima, Syed Ali Abdur Rahman & J. Arun

Title: Application of nanomaterials for the removal of heavy metal from wastewater

Publisher: Springer, 339-351

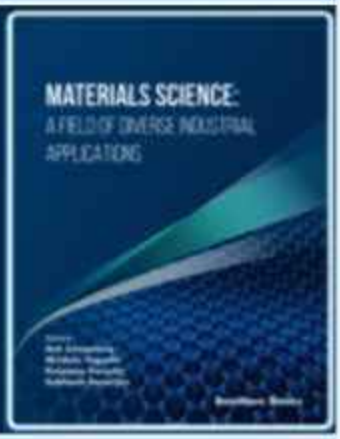
https://doi.org/10.1007/978-981-99-3292-4_16

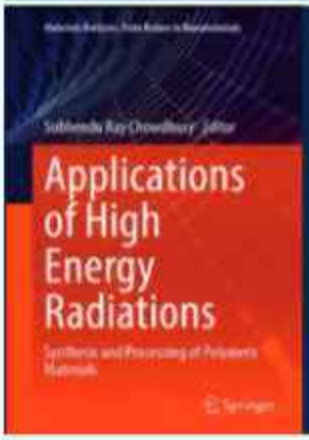
Kamakhya Prakash Misra

Title: Al Doped ZnO Thin Films: Beginning to Developments Afoot

Publisher: Bentham Science, 46 -62

DOI: 10.2174/9789815051247123010005





Ashish Kumar and T. Venkatappa Rao

Electron Beam Irradiation Induced

Title: Compatibilization of Poly (lactic acid) Based Blends

Publisher: Springer Nature Publications, 79-106

DOI: 10.1007/978-981-19-9048-9

Shivani Dhall, Rashi Nathawat, Kapil Sood

Title: Carbon-based nanomaterials

Publisher: Elsevier, 3-39

https://doi.org/10.1016/B978-0-12-822837-1.00008-3

Rashi Nathawat, Satyapal S Rathore, Poonam R Kharangarh, Reena Devi, Anita Kumari

Title: Synthesis and application of carbon-based nanocomposite

Publisher: Elsevier, 169-203

https://doi.org/10.1016/B978-0-12-822837-1.00005-8

Ongoing Projects

Title: Polyextremophiles from Extreme Regions of Rajasthan: Isolation, Molecular Characterization and their Potential Biotechnological Applications
PI: Dr. Ashima Bagaria
Funding Agency: DST, Rajasthan

Title: The facile and low-cost solution for wastewater treatment based on ceramic nanocomposite materials
PI: Dr. Pushpendra Kumar
Funding Agency: SERB-SURE

Title: Layered Double Hydroxides as electrode for Sustainable Green Hydrogen Energy via Water Electrolysis: A Novel Approach for Clean Energy Generation
PI: Dr. Pushpendra Kumar
Co-PIs: Dr. Ajay Saini & Dr. K. Nagaraja
Funding Agency: Manipal Research Board (MRB)

Title: Development of Organic-Inorganic hybrid composites and their studies
PI: Dr. Rashi Nathawat
Funding Agency: UGC-DAE CSR, Indore

Title: Fabrication of [(PANI)$_{1-x}$ – (V_2O_5)$_x$] based gas sensor
PI: Dr. Rashi Nathawat
Funding Agency: Miety-INUP, IIT Bombay

Title: Enthalpic and Dielectric Relaxations in Polymer-based Ferroelectric Materials
PI: Dr. Manoj Kumar Saini
Funding Agency: SERB-SRG

Title: Fabrication of Isotopic Sn-target for nuclear fusion-evaporation reaction
PI: Dr. Shashi Shekher Tiwary
Co-PI: Dr. Ashish Kumar
Funding Agency: Manipal University Jaipur Enhanced Seed Grant

Title: Investigation of Atypical Space Plasma Solitary Waves Induced By Charged Space Debris: An Indirect Detection Technique of Space Debris Objects
PI: Dr. Abhik Mukherjee
Funding Agency: Manipal University Jaipur Enhanced Seed Grant

Title: Development and evaluation of Liquid Crystals of Amphotericin B to treat fungal infections in brain through nose to brain delivery
PI: Dr Anup Naha
Co-PI: Debanjan Bhattacharjee
Funding Agency: Manipal Research Board (MRB)

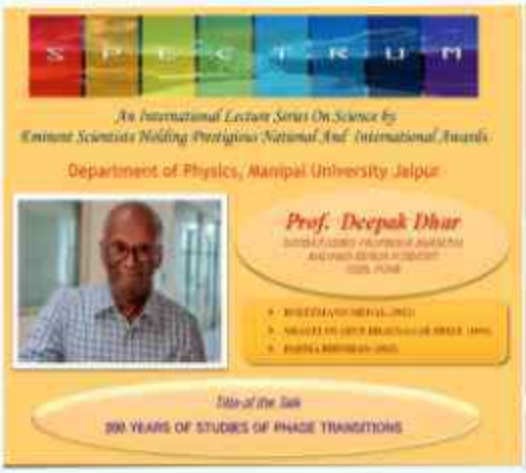
Title: A green and physical approach to fabricate bio-based, and biodegradable cost-effective nonwoven agrotextile using Ionizing radiation
PI: Dr. Ashish Kumar
Funding Agency: Manipal University Jaipur Enhanced Seed Grant

Guest Talks in 2023

SPECTRUM:

Spectrum is an international lecture series organized by Department of Physics, MUJ with the goal of bringing together eminent scientists from different branches of science for a scientific lecture series on their research work. The scientists who have received prestigious national/international research awards like The Shanti Swarup Bhatnagar Prize for Science and Technology (SSB), Boltzmann Award, Fundamental Physics Prize, Fields Medal, Dirac Medal, Abel Prize, Padma Award etc will be delivering their pathbreaking research and futuristic ideas. The ultimate goal of this program is to invite a Nobel Laureate scientist on this platform. The program consists of Keynote Address, Invited Lectures, panel discussions etc.

The chief guest of the program was Dr. Deepak Dhar, who is a distinguished theoretical physicist known for his contributions to the field of statistical mechanics and condensed matter physics. Dr. Dhar graduated in science from the University of Allahabad, earned a master's degree in physics from IIT Kanpur, received his PhD degree from California Institute of Technology (Caltech), where he worked under the guidance of Professor Jon Mathews. Following the completion of his Ph.D., Dr. Dhar returned to India to join Tata Institute of Fundamental Research (TIFR). After retirement, he assumed the position of a distinguished professor at the Indian Institute of Science Education and Research (IISER), Pune.



International Faculty Visit:

Prof. R.D.K. Misra visited the Department of Physics to enhance collaboration in the area of materials science and engineering. He visited the undergraduate and post graduate laboratories of the department and took a good impression of the departmental infrastructure. Prof. Misra interacted with faculty members of the department and explored the possibilities of active collaboration in the domain of biomaterials and high entropy alloys etc. He also visited the central facilities of the universities Sophisticated Analytical Instrumentation Facility (SAIF) and Central Analytical Facility (CAF).

AISA:

An online webinar '**Academia-Industry Symbiotic Alliance (AISA)**' was held on 08 August 2023. The invited speaker was **Dr. Pramod Mulbagal Rajanna,** Senior Technical Manager (R&D), HHV Advanced Technologies, Bengaluru. The event was conducted on the Microsoft Team platform and was hosted by Dr. Nilanjan. At first, Dr. Nilanjan made an introductory note about significance of this event and introduced the speaker. In the event, speaker discussed about different techniques of thin film fabrication by physical vapor deposition. He talked about the different equipment introduced by Hind High Vacuum in the market. He presented brief account of India government vision on semiconductor and optoelectronic materials. The speaker also discussed the current trends in the application of thin films.

The registered participants in the event are young researchers and UG/PG students. The questions raised by the young participants were also addressed by the speaker. The event ended with a vote of thanks given by Dr. Anupam Sharma.

International Lecture:

This special international webinar has been organized as a part of the collaborative program that exists due to the Memorandum of Understanding (MoU) between Manipal University Jaipur, India and M. Nalbandyan State University of Shirak, Armenia. The topic of the webinar was "On Some Applications of Physical Ideas in Mathematics: About the Casimir effect". The invited speaker was Dr. Vardan Manukyan, Associate Professor of the Chair of Mathematics, Physics and IT, Faculty of Mathematics and Natural Sciences, State University of Shirak, Armenia. His main area of research is quantum vacuum phenomena in dS spacetime with an arbitrary number of spatial dimensions, field quantization in the presence of background gravity and nontrivial topology such as cosmic strings, study of the Casimir effect, methodological inquiries related to physics and mathematics teaching.

Industry Expert Talk:

Department of Physics and Department of Electronics and Communication Engineering organized an online event. The event was specifically designed for Physics and Electronics and Communication Engineering students. The guest of the event was Dr. Sarthak Kalani, who is an Engineer in Qualcomm in Santa Clara, California, USA. He is specialized in AMS Design. He did his PhD from IIT Delhi.

The talk was giving an overview on introduction, difference domains in VLSI, job opportunities, future studies in VLSI. It involves a process of creating and integrated circuit by combining thousands of transistors into a single chip. Its application is in modern electronics. He elucidated digital design which involves the use of digital logic circuits (NAND, NOR, Flip Flops) to process digital signals. It includes designing, testing and verifying digital circuits. Digital design involves creating complex digital circuits that perform different operations on a single chip.

Dr. Sarthak discussed the role of device Physics in VLSI. Device physics is study of physical behaviour of Semiconductor devices. It involves understanding various physical principles involved in designing and testing semiconductor devices. It enables to predict device behaviour and design better and more efficient devices. Completing different domains in VLSI, job opportunities in VLSI were discussed. Some of the job titles were - Chip design engineer, verification engineer, application engineer process engineer.

BOPM:

The Department of Physics, Manipal University Jaipur, has its signature event - Webinar series on **'Blend of Physics & Materials (BOPM)'**. In this series, the experts working particularly in the domain of interface of Physics and Materials research from across the globe showcase their research work. The webinar series aims to bring together aspiring research scholars, faculty members and senior undergraduate and post graduate students who are willing to learn cutting-edge materials research. We believe such webinar series will offer an excellent opportunity to inquisitive minds to learn many new things.

Events and Activities

India in G20:

Science, Society and Sisterhood: India has assumed the G20 Presidency and will convene the G20 Leaders' Summit for the first time in the country in 2023. Department of Physics, Manipal University Jaipur (MUJ) takes full pride and joy in celebrating this great moment with a theme 'India in G20: Science, Society and Sisterhood'. In this term a series of events has been organised by the Department, where the participants witnessed the historic moment with exuberance, confidence, and self-reliance.

This event presents an engaging and thought-provoking quiz and debate competition on the intriguing topic of "Modern Science vs Ancient Science - From the Perspective of Indian Society." This event served a platform where participants were delved into the contrasting realms of scientific ideologies that have shaped India's rich cultural heritage and its modern scientific advancements.

Donation Drive:

The Department of Physics in collaboration with 'COSMOS-The Science Club' and Directorate of Student Welfare organized a societal connect event at Matra Chaya Bal Grah for donation drive. The aim of the event was to bring joy, learning, and a sense of community to the children residing in the orphanage.

RAMSACT:

The School of Basic Sciences (SBS) introduced the international conference on 'Recent Advances in Material Science and Computational Techniques (RAMSACT)'. In September 2023, the 3rd edition of the RAMSACT series is led by the Department of Physics in collaboration with the Department of Computer Application. The platform RAMSACT was created with the goal of bringing together prominent academic scientists, researchers, and research scholars to discuss and share their experiences and research findings to exchange knowledge with each other. During this conference, we received nearly 115 abstracts, and after reviewing we allowed 96 contributors to present their work in RAMSACT-2023 in different sessions. After a rigorous review process, nearly 70 papers were selected to communicate in Scopus-indexed journals. Journal of Nano-and Electronic Physics (JNEP), NanoWorld Journal (NWJ), Proceedings of the Indian National Science Academy (PINSA), and AIP Conference Proceedings (AIP Publishing) have given their consent to become our publication partners.

Conference Presentations - Faculty and Research Scholar

A. Oral Presentations			
Name	**Conference Name**	**Date**	**Place**
Ms. Kanchan Soni	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur
Ms. Richa Sharma	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur
Mr. Akshay Jain	4th International Conference on Condensed Matter and Applied Physics	09-10 October 2023	Government Engineering College, Bikaner
Ms. Karishma Jain	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur
Dr. Sushil Kumar Jain	Recent Advances in Science and Engineering (RAiSE- 2023)	04-05 October 2023	MAHE Dubai
Dr. Sushil Kumar Jain	International Conference on Advances in Material Science and Chemistry (ICAMSC-2023)	02-04 November 2023	Amrita Vishwa Vidyapeetham, Kollam, Kerala
Ms. Karishma Jain	3rd International Conference on Recent Trends in Environment and Sustainable Development (RTESD 2023)	22-24 December 2023	Vivekanand Global University, Jaipur
Dr. Anupam Sharma	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur
Dr. Anupam Sharma	6th International Conference on Nanomaterials for Energy and Environment Nano E2	21-23 December 2023	Kolhapur, Maharashtra
Dr. Rashi Nathawat	International Conference on recent advances on fluid mechanics and Nanoelectronics (ICRAFMN)	12-14 July 2023	Manipal Institute of Technology, Bangaluru
Mr. Vipul K Sharma	International Conference on recent advances on fluid mechanics and Nanoelectronics (ICRAFMN)	12-14 July 2023	Manipal Institute of Technology, Bangaluru
Mr. Sanjay Kumar	International Conference on recent advances on fluid mechanics and Nanoelectronics (ICRAFMN)	12-14 July 2023	Manipal Institute of Technology, Bangaluru
Mr. Ashish Somvanshi	International Conference on recent advances on fluid mechanics and Nanoelectronics (ICRAFMN)	12-14 July 2023	Manipal Institute of Technology, Bangaluru
Mr. Ashish Kumar Kumawat	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur, Jaipur, Rajasthan
Ms. Kriti Kumari	28th International Conference on Nuclear Tracks and Radiation Measurements	6-10 November 2023	Gurugram University, Haryana
Dr. Abhik Mukherjee	Recent Advances in Material Science and Computational Techniques (RAMSACT 2023)	20-21 September 2023	Manipal University Jaipur, Jaipur, Rajasthan

B. Poster Presentations			
Name	**Conference Name**	**Date**	**Place**
Ms. Bhakti Tripathi	28th International Conference on Nuclear Tracks and Radiation Measurements	6-10 November 2023	Gurugram University, Haryana
Dr. Ashish Kumar	International Conference on Advanced Applications of Radiation Technology (NICSTAR-2023)	9-12 January 2023	Kochi, Kerala, India

Invited Talks by Faculty Members

Date	Event	Venue	Faculty
20-22 December 2023	International Conference on Atomic, Molecular, Material, Nano & Optical Physics with Applications (ICAMNOP-2023)	Delhi Technological University, New Delhi	Dr. Ashima Bagaria
25-26 April 2023	National conference on advancement in polymer materials (APM-2023)	Pantnagar, Uttarakhand	Dr. Pushpendra Kumar
6-8 July 2023	International Conference on Thin Films & Nanotechnology: Knowledge, Leadership, & Commercialization	Indian Institute of Technology Madras, India	Dr. Pushpendra Kumar
11-17 July 2023	Karyashala on Fabrication of Nanocomposites and their Dielectric Spectroscopy	AMITY University, Jaipur	Dr. Pushpendra Kumar
20-21 September 2023	International Conference on Recent Advances in Material Science and Computational Techniques (RAMSACT-2023)	Manipal university Jaipur	Dr. Pushpendra Kumar
January 2023	2nd International Conference on Multidisciplinary Academic Research and Innovation	Aryabhat Institute of Academics and Research Lucknow, India	Dr. Kamakhya Prakash Misra
April 2023	2nd International Conference on Advance Interdisciplinary Research (ICAIR-2023)	Digvijay Nath Post Graduate College, Gorakhpur, UP, India	Dr. Kamakhya Prakash Misra
October 2023	2nd International Conference on Research Methodology (ICRM-2023)	Dr Shakuntala Misra National Rehabilitation University, Lucknow, India	Dr. Kamakhya Prakash Misra

PhD Awarded in 2023

Dr. Yogesh Kumar
Thesis Title: Structural and Magnetic Properties of Co and Ni based Nanocaps Deposited onto Self- assembled Polystyrene Nanospheres
Guide: Dr. Anupam Sharma
Co-Guide: Dr. Jitendra Tripathi
Thesis defense: 23 August 2023

Dr. Ankit Sharma
Thesis Title: Impact of Co-Dopants (Ag, Cu, Ce) on Structural, Optical and Magnetic Properties of Al Doped ZnO Nanostructures
Guide: Dr. K. P. Misra
Co-Guide: Dr. Rama Kanwar Khnagarot
Thesis defense: 22 September 2023

Dr. Vipul K Sharma
Thesis Title: A systematic approach towards the development of magneto-electric composites as energy harvesters
Guide: Dr. Satyapal S Rathore
Co-Guide: Dr. Rashi Nathawat
Thesis defense: 26 October 2023

Photo Gallery


LabRAM HR Evolution
HORIBA

Editor's Note

Dear Reader,

I am delighted to present the Annual Report for the Department of Physics, showcasing the outstanding achievements of the past year. This report highlights the exceptional research papers, innovative projects, and the distinguished profiles of our faculty members.

Our department has seen significant advancements in various fields of physics, with numerous publications and groundbreaking projects. The research summaries provided here reflect the dedication and expertise of our faculty and students. The past year has also been enriched with numerous events, conferences, and workshops, fostering a collaborative and vibrant academic atmosphere. The accolades and achievements of our department members are a testament to our commitment to excellence.

Thank you for your continued support.

Dr Manoj K Saini
Assistant Professor, Dept of Physics, MUJ


INSPIRED BY LIFE