RAMAN MEMORIAL CONFERENCE - 2021

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Abstract Booklet of Thesis Presentation (TP)/ Oral Presentation (OP)/ Poster Presentation (PP)

Date: 4th-5th March, 2021

Invitee's Abstract

KEY NOTE

"Celebrating One Hundred Years of Nobel Prize on Photo Electric Effect"

Dr. Avinash Khare

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Abstract

After briefly discussing the photo electric effect and its explanation by Einstein in terms of photons and hence dual nature of light I shall discuss how it has influenced several conceptual developments including dual nature of matter, Schrödinger's Wave equation for material particles, popularly known as Schrödinger equation, uncertainty principle. I will also emphasis the role played by photon as mediating particle of electromagnetic interaction and hence development of most accurate theory in science, i.e. quantum electrodynamics and subsequent development of the so called Standard Model of Particle Physics. As an illustration, I shall briefly discuss the standard model and the discovery of Higg's particle. I will end my talk by raising an open question: Is there an analogue of photo electric effect in gravity? If yes what it is and can it lead to the discovery of graviton and hence dual nature of gravity?

Invited Talk - I

"Fundamentals and Result Analysis of Raman Scattering Spectroscopy Technique"

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Abstract

In this talk selective Raman spectroscopy results collected on large number of samples illustrating the strength of micro-Raman spectroscopy will be discussed. An introductionto the Raman spectroscopy will cover the fundamental principles of Raman spectroscopy essentially required for analyzing Raman spectra. It will be followed by results on nano-structures that have been investigated for large number of users across the country in our laboratory. Few examples of the Raman microscopy that is very useful in mapping different parts of the sample giving information about spatial distribution of various phases will be shown. It will be shown in details the effect of size on the Raman spectra and its interpretation in terms of quantum size effects etc. Some examples of Resonant Raman studies on nano particles and single crystals will be discussed. A flavor of workour group is involved in the use of Raman spectroscopy in highly correlated systems in transition metal oxides and Perovskites will also be given. The strong coupling between charge, spin and lattice degrees of freedom are clearly brought out in Raman spectra collected on single crystal and epitaxial thin films. The effect of magnetic order on phonon structure gives anomalous softening of some modes that gives information about the strong spin-lattice coupling present in these systems. The signature of Jahn-Teller distortion in the Raman spectra of manganites will be illustrated and its role in driving system from insulating to metallic phase will be discussed. If time permits some of our recent results on electronic Raman scattering studies will be shown. Recently we couldfor the first time observe femto-meter shifts of ions from its centro-symmetric position leading to ferroelectricity in oxides through polarized Raman spectroscopy. The role ofsample orientation, Raman tensors and incident polarization will be illustrated.

Invited Talk – II

"Materials *Innovations & Emergent Applications Frontiers"*

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Abstract

The world is changing very rapidly with several emergent applications domains appearing on the horizon every few months. These cover all spheres of human activity, primarily encompassing the key challenges such as energy, environment, health, and water. Revolutionary changes are being encountered in various sectors such as transportation, defense, aerospace, biomedical instrumentation, electronics (including flexible or wearable electronics), optoelectronics, spintronics, and Internet of Things (IOT). Most interesting solutions in these fields necessarily ride upon the promise of materials discovery and innovation involving targeted designs of a variety of materials systems, their compositions, morphologies, and architectures. Nanomaterials, hybrid materials, soft materials, low dimensional materials, and bioinspired materials are contributing enormously to the research novelty in this respect, promising major advances in years to come. In this talk, I will first lay out this broad scenario and its keyscientific directions, and then give several examples to show where we are heading andhow; and what a young researcher should do to be an active participant in and key contributor to this exciting journey.

Invited Talk – III

"Inner life of cells - Motion in crowded environments"

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Abstract

Living systems offer a challenging array of problems to a physicist, allowing us to use the traditional tools of physics to understand how biological systems function. In this talk, I will give a brief overview of motion inside a cell, and how the extremely crowded environment inside cells affects physical processes and can give rise to counterintuitive phenomena. In particular, I will discuss the problem of one-dimensional diffusive motion of a protein particle along a polymer (DNA) chain in the presence of multiple obstacles, and how this apparently simple physics problem can reveal insights into how our genome is organized inside the cell nucleus.

Invited Talk – IV

"Electronic DFT for Real Materials : A Guided Tour"

Prof. Dr. G.P. Das

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Abstract

There are many reasons for Density Functional Theory (DFT) to have established itself as the unchallenged workhorse for first-principles materials specific simulations, its simple conceptual framework, practical elegance, and amenability to meaningful ramifications. DFT has proved itself to be extremely handy tool in understanding the physical and chemical properties of materials from bulk to nano, and also in designing novel materials with desired combination of properties. In this talk, I shall try to provide a glimpse at the different basis sets being used to solve Kohn-Sham equation for various kinds of materials and their properties. While plane wave based methods are being widely used for tackling a large variety of problems, atom-centered (spatially localized) energy dependent basis functions such as Muffin-tin orbital methods providing the possibility of transforming to a short-ranged tight-binding like basis via screening transformation. This approach combines efficiency with accuracy and also helps extracting the chemical information in a transparent way. I shall also touch upon some recent developments on full potential implementation of this approach, that has been coupled with LDA+U, GW and the dynamical mean field theory (DMFT). This talk is aimed at Masters / PhD students, young researchers (including experimentalists who are desirous of using DFT codes) who want to have a working knowledge for using DFT based electronic structure methods.

Invited Talk – V

"The solid state avatar of Majoran Fermion"

Dr. Sourin Das

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Abstract

In the nineteen thirties, Majorana predicted the existence of fundamental fermionic particles which are peculiar in the sense that they are their own anti-particles. However, the discovery of such particles still elude us. In the context of condensed matter physics, the term Majorana fermions refer to topologically protected bound states which are equal superposition of particle and hole excitations (hence they are their own anti-particles) and these are hosted at the boundary of one dimensional topological superconductor. In this talk, I will give a brief introduction to the idea of this topological state of matter followed by a comprehensive introduction to the condensed matter avatar of Majorana fermions. Then, I will discuss the recent experimental progress in the field which provides strong evidence that such excitations do exist. I will touch upon the relevance of Majorana fermions in the context of Non-Abelian braiding statistics and related applications in topological quantum computation. I will conclude with some discussions of our own effort in Pursuit of Majorana fermions.

TP - 01

Synthesis and study of quaternary chalcogenide absorbers for solar cellapplications

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Abstract

Thin film chalcogenide solar cells are promising photovoltaic technologies. $Cu(In,Ga)Se_2$ (CIGS)-based devices are already produced at industrial scale and record laboratory efficiency surpasses 22 %. The quaternary Cu_2ZnSnS_4 (CZTS), being related to the highly successful CIGS and $CuInS_2$ materials, is a promising candidate for thin film photovoltaic devices. The direct band gap about 1.5 eV, large absorption coefficient $>10^4$ cm^{-1}, no rare or expensive elements of CZTS absorber gained considerable attention for low cost thin film solar cells. CZTS device efficiency above 12 % has been obtained, indicating a high potential for improvement.

In this work, different ways to strengthen CZTS absorber layers are investigated for high- performance solar cell applications. This work aims to study the influence of different synthesis parameters on the performance of CZTS absorber thin films.

Firstly, we synthesized and investigated the suitable Molybdenum (Mo) back contact thin films for CZTS solar cell deposited by using DC-magnetron sputtering unit. Along with this study, we prepared CZTS and CZTSe nanocrystals using hot injection method and studied different physicochemical properties of nanocrystals. We prepared thin films of same CZTS and CZTSe nanocrystals using spin coating and observed 4-5 times better photoresponse in CZTSe than CZTS thinfilms.

In further work, CZTS absorber were grown using RF-magnetron sputtering vacuum depositiontechnique, followed by a heat treatment in Ar (95%) + H_2S (5%) environment at ambient pressure. Weused Cu, ZnS, and Sn sputtering target as a source of Cu, Zn and Sn.

In first part, CZTS absorber thin films were fabricated using two different ways, (i) two-step synthesis includes deposition of metal precursors (Glass/Mo/ZnS/Sn/Cu) followed by sulfurization and (ii) three-step synthesis includes deposition of identical metal precursor, soft annealing (preheating) and sulfurization. The structural, morphology, opto-electronic properties are studied using different characterization techniques and concluded that three-step synthesis approach with 550 °C sulfurization temperature give good quality CZTS crystals, enhanced grain size, compact morphology and raised photoresponse of the CZTS absorber films.

In second part, we have studied the change in stacking order of precursors like Glass/Mo/ZnS/Sn/Cu, Glass/Mo/Sn/ZnS/Cu and Glass/Mo/Sn/Cu/ZnS. By changing precursor order morphology of precursor significantly changes and Glass/Mo/Sn/ZnS/Cu precursor order gives us larger surface area for buffer layer junction formation with good crystal quality and better photoresponse. Due to inevitable metal inter-diffusion during the sulfurization, we studied the effect ofthe Sn/Zn/Cu metal stacking number on the quality of thin film with respect to its performance. The prepared CZTS with conventional 3-layer

stack, due to insufficient inter-diffusion of precursors, low crystalline fraction volume was developed in CZTS film than the 6-layers and 9-layers and resulted in poor photoresponse. By using the modified 9-layers stacked precursor the performance of CZTS thin films increase relatively by 331% than 3-layers and 115% than 6-layers. Finally, in this work, the modified stacking (9-layers) metallic precursor possesses definitely enhance the CZTS solar cell performance.

Keywords: CZTS, Molybdenum, Sputtering, Hot injection method, solar cell

TP – 02

Effect of core/shell nanocrystals on the optical and electricalproperties of ferroelectric liquid crystals

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Abstract

The terminology "liquid crystal" (LC) may first appear to be a contradiction in terms, but it is indeed a genuine intermediate state of matter with many fascinating properties and practical applications. Currently, liquid crystals displays (LCDs) are extensively used in computers, televisions, wrist-watches, pocket calculators, aircrafts and many appliances to transfer alphabetic and numerical information to the user. Since last decade liquid crystal research is not only focused on LCDs, but also new devices such as spatial light modulators, 3D glasses, optical fibers, etc. In addition to this, LCs are also being used in non-display applications like biosensors, photovoltaic cells, volatile memory devices, etc.

Nematic liquid crystals (NLCs) are the simplest LC phase which have been widely used in LCDs. However slow response and low power operation is always an issue of concern in the LC devices. In spite of the variety of LC phases, LC showing the chiral smectic C (*SmC**) phase, known as ferroelectric liquid crystal (FLC), is quite promising phase due to their significant properties like spontaneous polarization, high contrast ratio, lower threshold voltage, faster electro-optical response, wide viewing angle, memory effect, etc.

In recent years, the emergence of nanotechnology and its development in the synthesis of nanocrystals (NCs) having different sizes, shapes and compositions have proved to be an advantage over other non-mesogenics (organic dyes, fluorescent molecules, etc.). Mixing of two active fields, namely nanotechnology and soft materials has further inspired the researchers looking not only for performance improvement but also to impart novel properties in potential FLC based devices.

Here in present thesis, we have synthesized and characterized different core/shell (CdSe/ZnSe, Co:ZnO/ZnO, Au/SnO_2) incorporated in host FLC (KCFLC 7S) material and investigated the effect of different nanostructure materials on the electric, optical, dielectric and magnetic properties of commercially available ferroelectric liquid crystal mixture (KCFLC 7S), possessing chiral smectic C (*SmC**) phase. Initially, we have taken highly luminescent CdSe/ZnSe (semiconductor/semiconductor) graded core/shell (CZ) NCs (size ~5 nm) to incorporate in the host FLC material. In the second part of work, we focused our study on diluted

magnetic semiconductor, Cobalt doped ZnO core having shell of ZnO, (CZZ) NCs having size ~5 nm, incorporated in the FLC material. Furthermore, FLC composite with larger metal/semiconductor (Au/SnO_2) core/shell NCs (size ~54 nm) are also explored. Studies are also extended on the FLC composite with small sized (~5 nm) perovskite $CsPbBr_3$ NCs.

A suitable amount of core/shell NCs was added systematically into FLC (KCFLC 7S) material and studied using polarizing optical microscope, ferroelectric, PL and dielectric measurements. The composition of core of NCs is different in each case, while shell thickness and size was maintained constant. Polarizing optical microscopy demonstrates uniform texture and reduced light leakage centres in its dark state which is the sign of improved molecular alignment. A noteworthy decrease in operating voltage and improvement in optical brightness, dielectric loss factor are assigned to the improved order parameters (θ, P_S), and hence anchoring/ordering of FLC molecules in presence of NCs. The enhancement in PL is conjectured to be due to an increase in molecular alignment/dynamics yielding higher absorption which is confirmed by excitation spectra. The experimental facts can be understood on the basis of variation in the internal structure of core/shell NCs having minimal possibility of charge leakage from core to shell or LCs. This observation is further corroborated by the PLE spectra and helical pitch measurement. Furthermore, the co- existence of ferroelectric and ferromagnetic ordering is also shown with the addition of appropriate amount of diluted magnetic semiconductor/semiconductor core/shell NCs into FLC material. Observed sustained soft multiferroicbehavior could be attributed to the coupling between ferroelectric and ferromagnetic order parameters without perturbing intrinsic magnetic field of NCs and the director field of the FLC molecules by each other.

Keywords: nanocrystals, liquid crystals, core/shell, polarizing optical microscope

TP – 03

Lead-free halide perovskite materials for solar cell applications: Experimental and theoretical approach

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Abstract

Crystalline silicon solar cells have been continuously advancing in efficiency over the last 40 years and have been capable in producing electricity from solar energy at a reduced cost of fabrication. Other newer solar cell technologies ranging from thin-film vapor-deposited semiconductor-based solar cells like CdTe or CIGS, to solution-processed solar cells based on organic semiconductors, hybrid composites or inorganic semiconductors have promised even lower cost solar power. However, the device performances of these materials have not shown considerable improvement until the emergence of a new class of organic-inorganic hybrid materials named "Perovskites". The hybrid halide perovskites have emerged in recent years as an exceptional class of materials delivering solar cell efficiencies greater than 25%, displaying promising light-emission properties and exhibiting extraordinary phenomena relating to spintronics, laser-cooling etc.

The first report on the potential of halide perovskites in PV energy conversion appeared in 2009, wherein the authors employed hybrid organic-inorganic perovskite $CH_3NH_3PbI_3$ as a light sensitizer in dye-sensitized solar cell and demonstrated a power conversion efficiency (PCE) of 3.8 %. Halide perovskites are not only capable of absorbing light but also act as efficient electron and hole conductors. These works marked the beginning of a global research effort to push the performance of perovskite solar cells to the highest certified efficiency of 25%. The prototypical compound of this family is methylammonium lead triiodide , $MAPbI_3$.

MAPbI3 exhibits a number of remarkable properties that make it ideal for optoelectronic applications. It is a direct-gap semiconductor with a band gap of 1.6 eV at room temperature, a strong light absorger with absorption coefficient ~ 5 x 104 cm-1 which is about 25 times higher than in silicon and GaAs. Extremely sharp absorption onset, small Urbach energy (13 meV), long-lived photogenerated electrons and holes, long diffusion lengths (~ 1µm), balanced electron and hole effective masses, ambipolar charge transport are other outstanding properties of this material that makes it the "first high quality halide semiconductor". Apart from the above mentioned properties, the ease of fabrication of these films using inexpensive solution-processing routes makes them ideally suited for scaling up the production. However, the instability of lead halide perovskites (LHP) under light, moisture and other ambient conditions, toxity of Pb have hindered the commercialization of LHP devices. This has triggered the research community to search for non-toxic, earth abundant and stable alternatives to Pb.

This thesis investigates a number of lead-free perovskites and perovskite derivatives for their suitability as solar absorbers. Some of these materials have been experimentally synthesized and characterized to check for their properties. At the same time, Density Functional Theory (DFT) has been implemented to

provide insight into the structural, electronic and optical properties of these materials that determine real-world-performance

Keywords: Perovskite, DFT

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OP - 01

Structural analysis of broadband emitting 2D hybrid perovskites

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Abstract

The material class of hybrid perovskites has been extremely popular in the area of optoelectronic devices due to their high tunability, easy synthesis, novel properties and exciting new physics. The strong attributes such as wide range of solar absorption, solution processability, low processing cost, band gap tunability through chemical composition, direct photogeneration of free carriers, efficient charge transport (> 10 $cm2V^{-1}s^{-1}$), long carrier diffusion lengths (>= 1µm),low Urbach energy (<15 meV) and low trap density (<$1016cm^{-3}$) have a tremendous contribution in its raise as a potential material for various optoelectronic devices. [1] Researchers have been probing the fundamental process governing the vibrant and extremely ideal properties exhibited by these materials in the context of optoelectronics as well as related areas. The study of single crystals has proved to exceptionally useful in this regard. [2] The accurate structural data provided by the analysis of single crystal X-ray diffraction (Sc-XRD) provides a backbone for theorist to share their perception on basic properties with greater accuracy and insight. Here, using the technique of Sc-XRD analysis we probe the family of low dimensional 2D hybrid perovskites which are broadband emitters. Thus, we have provided insights into the photo-physical properties through structural analysis. We present in-depth analysis of the structural parameters to understand the role and impact of intrinsic defects which contribute in achieving white emission from these materials. [3]

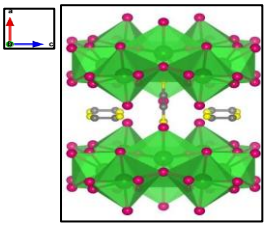

Figure: 2D Layered hybrid perovskite, (EDA)2PbCl4 the unique Pb-Cl metal halide framework promotes self-trapping of excitons due to intrinsic defects.

Keywords: hybrid perovskites, structural analysis, photophysics, optoelectronics.

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OP - 02

TL study of calcium pyrophosphate irradiated with carbon ion beam

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Abstract

Dysprosium doped calcium pyrophosphate phosphor has been synthesized using chemical co-precipitation method. The synthesized phosphors were characterized using powder X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), photoluminescence (PL), and thermoluminescence (TL) studies. The SEM and TEM analysis confirmed the formation of submicron-phosphors. However, PL study was carried out to confirm the presence of dopant ion in the host matrix. TL glow curves were recorded for different concentrations of dysprosium after exposure to various fluences of carbon ion beam at IUAC, New Delhi [1]. The absorbed doses, ion range and main energy loss were calculated using TRIM code based on the Monte Carlo simulation. Theoretical analysis of the glow curves of the phosphor irradiated by carbon ions was done by glow curve de-convolution (GCD) method (Fig. 1) to determine the trapping parameters of various peaks [2]. The wide linear response along with the high stability of TL glow curve makes this material a good candidate for carbon ion beam dosimetry.

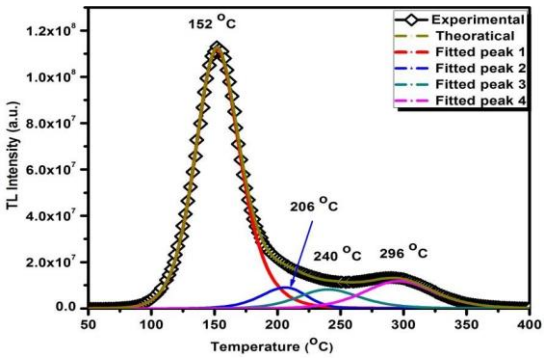

Figure: Comparison between the experimental and theoretically fitted TL glow curve of the calcium pyrophosphate phosphor

Keywords: Thermoluminescence; Dosimetry; Ion beam irradiation; TL kinetics

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OP - 03

Destruction of Superconductivity in percolating lead thin film

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Abstract

It is observed that the superconducting properties of the superconductors changes significantly with particle size. Nanostructured and disorder superconductors show outstanding phenomena which are used for different applications. Percolating thin films have nanoclusters with produced disorders due to different coverages. In this letter, we investigate percolating thin films of lead thin films which were deposited at room temperature. We have deposited the samples both at room temperature and at 10 K. The mentioned samples were deposited at room temperature with different onset resistance. The surface morphology of the thin films were studied using scanning electron microscope. The structure exhibited the heavy coalescence of nanoclustructures which were separated by small and thin necks. Superconducting properties were studied using Janis research ST 400 Cryostat. The samples were cooled down to liquid helium temperatures and R(T) and V(I) measurements were performed. The obtained data were analyzed using phase slip theory and Berezinskii – Kosterlitz – Thouless (BKT) transition.

OP -04

Study of Eu doped MgB_4O_7 phosphor gamma, electron and ion dosimetry for medical applications

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Abstract

High energy electrons, photons, and swift heavy ion (SHI), induced thermoluminescence (TL) dosimetric properties of Eu doped MgB_4O_7 phosphor is reported for the first time. A comparative study of structural, functional, optical properties of MgB_4O_7:Eu phosphor upon irradiation by various ionizing radiations such as 10 to 15 MV photons, 6 MeV electron, and 100 MeV Ag7+ and Ni7+ ions. The Eu doped MgB_4O_7 phosphor was prepared by facile hydrothermal method. The X-ray diffraction pattern of the material revealed its orthorhombic structure with crystallite size of ~ 30 nm. Correlation of stopping powers and projectile range calculations was performed via SRIM software. The TL glow curve of irradiated phosphor showed two major dosimetric peaks and also good linear dose response which is appreciable as compare to standard dosimeters. The fading measurements show only 10 % loss within the period of 2 months which is acceptable range as per standard dosimetry. Trapping parameter calculations of irradiated phosphors was done via various methods such as, peak shape method, whole glow peak method, and glow curve deconvolution method. Therefore, the as-achieved TL properties of MgB_4O_7:Eu phosphor makes them promising dosimetric phosphor material and will be used in low energy medical as well as ion dosimetric applications.

Figure: Medical Linear accelerator used at Cancer department, Vikhe Patil Hospital, Ahmednagar.

Keywords: MgB_4O_7, Thermoluminescence, Swift Heavy Ion, 100 MeV Ag7+ and Ni7+ ion, Glow Curve Deconvolution, Trapping parameters, Medical dosimetry, Ion dosimetry.

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OP – 05

PERFORMANCE ANALYSIS OF LEAD ACID BATTERY

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Abstract

Energy Storage plays a important role in sustainable development and promotion of renewable energy for mainstream applications.The lead acid battery was invented in 1859 by French physicist Gaston Plante and is the earliest type of rechargeable battery.The ability to supply high surge current means that the cells have a relatively large power-to-weight ratio. These features along with their low cost, make them attractive for use in motor vehicle to provide the high current required by starter motors. Batteries are the charge discharge cycle performance of lead acid battery has been analyzed in view ofaccurate estimation of state of charge at dynamic battery operations. The result shows different performance with different discharging rates. In this article we reported constant current discharging method on a VRLA Valve Regulated Lead Acid Battery and observed the discharge characteristics andcalculated the battery efficiency.

Keywords: Lead acid battery,VRLA,discharge characteristics,efficiency

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OP - 06

D.C. conductivity studies of lithium chromium ferrite

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Abstract

Fine powder of ferrite samples with general formula $Li_{0.5-x}Fe_{2.5-X}CrXO_4$ (X = 0.1, 0.2, 0.3, 0.4, 0.5) were prepared by standard ceramic method using analytical reagent grade Fe_2O_3, Li_2CO_3 and Cr_2O_3. The electrical resistivity of lithium chromium ferrite with temperature is calculated. Curve of Log(ρ) versus 103/T seems almost linear up to curie temperature. The resistivity goes on increasing with addition of Cr3+ values calculated are 7.3, 7.51, 7.65 and 7.82 in order of 109 ohm-cm at RT. Activation energy for conduction in the paramagnetic and ferrimagnetic region calculated. The activation energy in the para region is always greater than the activation energy in ferri region. The activation energy is also found to increase with chromium content.

Keywords: ferrite, conductivity, resistivity, curie temperature

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OP - 07

Study of Panicle Acceleration Mechanism during the formation of shocks in galaxy clusters formation

Gajanan D. Harale, Surajit Paul

Very high energy radiations that has been observed on the earth as particles showers, mainly consist of accelerated charged particles like electrons, protons and charged nuclei and non-charged particles like Gamma rays, neutrinos etc. Though galactic origin of these radiations are very well studied, many of the extragalactic origin has not been explored or remained un-explained. In this context, the biggest puzzle is the observed Gamma ray and neutrino background and their acceleration mechanism. Also, we have not yet detected Gamma rays from Galaxy clusters, the most energetic object known to us. Possibly, large scale structures emitting Gamma rays that creates this back ground, but at a particular state of its activity like mergers. During merging process the possible mechanism that can accelerate particles in Large Scale Structures and contribute to enhance the extragalactic Gamma Rays and neutrino population. We thus investigate the role of particle acceleration in the production of cosmic ray particles like gamma ray and neutrino in the structure formation shocks during formation of galaxy clusters as the mechanism for accelerating particles to such an ultra-high energy. We have studied this problem with both analytical and numerical methods. So, in this work, we will try to see how we can guide the observations by predicting correct objects by using our theoretical models of particle acceleration.

OP- 08

Densification of LaB_6 pellet shaped cathodes using novel plasma sinteringmethod

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Abstract

LaB_6 is one of the most promising materials used for electron emission application either in the form of hot or cold cathode [1]. Its refractory properties such as high thermal as well as chemical stability, high mechanical strength makes its advantageous over conventionally used cathodes. Densification of LaB_6 cathodes is necessary for their actual application in the electron gun [2].Densification of these cathodes can be achieved using high temperature sintering methods. However LaB_6 cathodes requires vacuum sintering as it forms oxides of lanthanum and boron after exposing to air at temperature above 700-800° C [3] . In the present work for the first time open arc plasma was used for densification of LaB_6 cathodes. High temperature of arc plasma causes rapid sintering of the cathodes and in addition to that it inhibits grain growth. Inert atmosphere in the arc plasma reactor prohibits oxidation of LaB_6 cathodes.

Nanocrystalline LaB_6 powders were synthesized by arc plasma gas phase condensation route using indigenously developed arc plasma reactor [4]. Synthesized LaB_6 powders were thoroughly characterized to investigate phase purity, optical and morphological properties. These as synthesized powders were then use to fabricate pellet shaped cathodes of 2mm thickness and 5mm OD and sintered in similar arc plasma reactor. Sintering properties of cathodes such as density, oxidation and grain growth were observed by varying different plasma parameters. After densification, cathodes were characterized using X-ray diffraction, Raman spectroscopy and FESEM to investigate structural and morphological changes in the cathodes. Density measurements were carried out using Archimedes principle using precise single pan laboratory balance. At optimized plasma parameters maximum density of 94 % has been achieved for LaB_6 cathode which is phase pure and contains nanocrystalline particles. In summery use of arc plasma for sintering is advantageous over conventional vacuum sintering methods as it is rapid sintering method and temperature can be easily varied using different plasma parameters.

Keywords: Lanthanum hexaboride, thermal plasma, densification

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OP – 09

Enhanced photocatalytic activity of N, P, co-doped carbon quantum dots: Aninsight from experimental and computational approach

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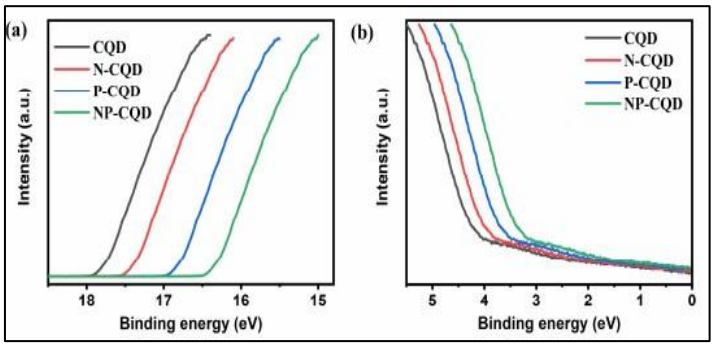
Abstract

A highly fluorescent nitrogen and phosphorus co doped carbon quantum dots (N,P-CQDs) were synthesized via single step microwave radiation assisted method and fully characterized through the various technique such as TEM, XRD, UPS and XPS analysis. The HRTEM Results reveals that as synthesized quantum dots are monodisperse, spherical shape with uniform size around (2-5) nm without any agglomeration. The as synthesized N,P-CQDs showed excellent optical properties and exhibited bright green colour under UV- light irradiation, The advanced NP-CQD exhibited improvement in visible light photocatalytic activity towards methylene blue dye degradation than that of N-CQD and P-CQD due to increase in the oxygen vacancies on the surface of CQDs it was well supported by XPS results as well as creation of new energy states thus decrease in its work function as confirmed by first principles Density Functional Theory (DFT) calculations and UPS.

Figure : Ultraviolet photoelectron spectrum of CQD, N-CQD, P-CQD and NP-CQD; (a) Esec edge and (b) EFE edge.

Keywords: Carbon materials; Nitrogen; Phosphor; Work function; Density functional theory



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OP – 10

Polymethyl methacrylate (PMMA) as a green dielectric for Electro wetting applications

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Abstract

We demonstrate the significance of Polymethyl methacrylate (PMMA) insulator in electrowetting (EW) for AC and DC voltages. The final bilayer dielectric was made from a few micron thick PMMA insulator and a nanometer thin hydrophobic layer. Effect of hydrophobic layers was examined by using Fluoropel, Teflon 1600 and Teflon 2400 as a top nano-meter layer on the PMMA insulator. The bilayers dielectric is extensively tested for specific capacitance using ac and dc voltage EW. It is seen that top nano-meter thin hydrophobic layer has no significant influence on the specific capacitance value for a constant PMMA thickness. Each bilayer film shows good contact angle reversibility, low contact angle hysteresis and high breakdown voltage. PMMA is a biocompatible, non reactive, cost effective polymer having good electrical insulation. Moreover, solvents like butyl acetate and DMF used for the depositing the PMMA are eco-friendly. PMMA has high adhesion on conducting glass substrate and not degrade or delaminate on long term exposure of water. Finally, we show that PMMA bilayer can be employed for fabrication of EW based liquid lens.

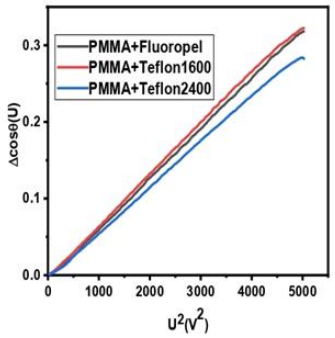

Figure 1: AC voltage EW graph of Δ cosθ(U) versus square of applied voltage (V^2)

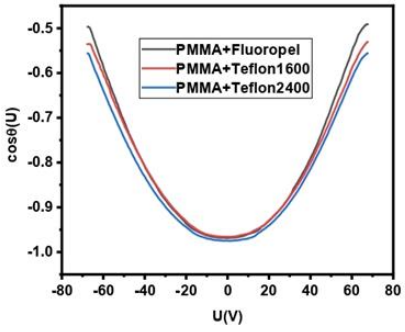

Figure 2: DC voltage EW graph of cosθ(U) versus applied voltage (V)

Keywords: Bilayer dielectric, PMMA, effective capacitance, delamination, liquid lens etc.

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OP -11

Design of compact mechanical facility based on 2.45 GHz microwave ion source for Plasma diagnosis and ion implanter facility

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Abstract

A 2.45 GHz microwave ion source-based, compact ion implanter, and plasma diagnostic facility have been taken up by the Central University of Punjab, Bathinda (CUPB). Complete mechanicaldesign of the present system has been carried out in such a way that both types of experiments: plasma diagnosis and ion implantation can be easily accommodated simultaneously and separately.Simulation optimization for the final design has been carried out in COMSOL as well as in Computer Simulation Software (CST). Overall optimization of present design includes enhanced microwave coupling, tunable axial-magnetic field, and a newly designed ring-based extraction system. In the future, this facility will be used for study of ECR plasma diagnosis, optical emissionspectroscopy (OES), ion implantation, surface patterning etc.

Keywords: Microwave coupling, Magnetic field, Extraction system.

OP - 12

Design and Development of low energy (5 keV to 100 keV) ion accelerator system for 2D material modifications

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Abstract

A low energy (5 keV to 100 keV) ion accelerator system is designed and developed for 2D material modifications. In this work the system development has been completed in the steps of Design, Simulation and Fabrication. The simulation work was carried out with the help of SIMION-7.0 and LORENTZ 3EM softwares. The system is composed of various components such as gaseous ion source, einzel lense, sector magnet, accelerator tube, experimental chamber, vacuum pump system etc. The source is made up of cathode, anode and an extraction electrode. We have characterized the developed ion source for different gas species by varying the gas pressure, ion energy and other parameters. Furthermore this ion irradiation facility was used for tailoring Structural, physiochemical, optical and electrical properties of GO, Polycarbonate, Stainless Steel Material etc.

Keywords : Ion Fluence, Graphene Oxide, Polycarbonate, stainless steel.

OP - 13

Radiation induced studies on Advanced Oxidation Process for the Degradation of effluents present in textile industrial wastewater

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Abstract

Artificial dyes play a major role in our daily life. These dyes have been used widely from clothing, handbags, footwears to furniture accessories. The extensive use of chemicals in organic dyes contains large number of carcinogenic compounds that are discharged in our water supplies unworriedly thereby disturbing the aquatic environment as well as human health. The population explosion and industry expansion of world needs an improvement in the existing technology for wastewater distillation, to provide required proper amount of water to everyone. In this work, advanced oxidation process (AOP) based on 6MeV electron irradiation technique for significant degradation of harmful pollutants present in single as well as mixed colored textile industrial wastewater is discussed in detail. It is observed that the electron irradiation dose plays an important role on the degradation rate. By varying the electron irradiation fluence, the degradation percentage of textile industrial wastewater was measured. The relative degradation percentage $\left(\frac{C_0-C}{C_0}\right)$>100 versus electron fluence of solutions clearly depicts that the decolourization rate increased with increase in electron irradiation fluence. This technique would be a preferable in order to decolouration along with decontamination in terms of reduction in COD. Almost decolouration with more than 75% COD reduction of textile industrial wastewater has been reported in absence of any harmful chemicals and reducing agents. Also, it is found that the electron irradiation method is chemical free and can be used in water purification systems and industrial wastewater treatment. Thus, it is confirmed that the irradiation induced degradation method is better as compared to other chemical degradation methods and effectively takes much less time.

Keywords: textile industrial wastewater, ionizing radiations, advanced oxidation process, degradation, irradiation fluence and 6 MeV electrons.

OP – 14

Thick target yield calculations of ^{211}At using the Excitation function of ^{209}Bi(a,2n)^{211}At nuclear reaction

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Abstract

Excitation functions for ^{209}Bi(α,2n)^{211}At and ^{209}Bi(α,3n)^{210}At reactions were calculated using TALYS-1.95 nuclear code from threshold to 50 MeV by invoking suitable options for level densities, nucleon-nucleus optical model potentials and alpha optical model potentials. The results were compared with the corresponding experimental data from the EXFOR database. Statistical factors were used to verify the quality of matching between theoretical model calculations and the experimental data. The results of the present study are important for the validation of nuclear model approaches with increased predictive power for ^{209}Bi(α,xn) reactions for the production of ^{211}At radioisotope.

PP - 01

Optimization of Gamma Ray Spectroscopy Technique for Measurement of Nuclear Pollution of Water samples due to Uranium and Thorium salts

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Abstract

Uranium and Thorium are naturally occurring radioactive elements in the earth crust, which emits alpha particles, gamma and beta radiations with long half-life of 1010 years. Though Uranium and Thorium are used as nuclear fuel in thermal and fast neutron reactor technology for the nuclear power generation, but it is hazardous for living life due to its harmful nuclear radiations. Salts of Uranium and Thorium are water soluble, therefore, they make the nuclear water pollution mostly at coastal areas where Uranium and Thorium storage in the earth crust are found. In view of this, efforts are made to optimize gamma ray spectroscopy technique to determine the concentration level of this radioactive material in water samples. In present work, it has been found that Uranium salt emits gamma radiation of energies 590 KeV, 750 KeV, 980 KeV, 1450 KeV, and Thorium salt emits gamma radiation of energies 340KeV, 570KeV, 910KeV. Concentrations of Uranium and Thorium in water samples are measured using NaI(Tl) gamma ray scintillation detector. Solutions of water samples are prepared with different concentration of Uranium and Thorium salt in the range 5% to 1.25% of Uranium and 1% to 0.125%of Thorium. The minimum detectable levels of concentration of Uranium and Thorium in water samples are found to be 0.058 gm and 0.005gm respectively. Estimated gamma ray activities of this minimum detectable level of the samples are found to be 0.0078Bq and 0.046Bqrespectively for Uranium and Thorium. This gives the specific gamma ray activities of 0.1327 Bq/gm and 9.2Bq/gm of Uranium and Thorium in water samples respectively.

Keywords: NaI(Tl) , Gamma Ray Spectrometer, Activity, Uranyl Nitrate, Thorium Nitrate, Nuclear pollution

PP -02

Study on electrical properties of electrodeposited CdTe thin films for photovoltaic applications

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Abstract

The aqueous electrolyte solution contains cadmium sulphates ($CdSO_4$), tellurium oxide (TeO_2) was used as sources of Cadmium and Tellurium ions respectively. The complexing agent Citric acid ($C_6H_8O_7$) has used to obtain the stoichiometric layers at desired potentials with an appropriate methodology. Cadmium telluride (CdTe) thin films have been prepared by using potentiostatic electrodeposition technique on to FTO coated glass substrates from an aqueous solution. A conventional three - electrode geometry was employed for the deposition of CdTe layers. Working (Fluorine doped tin oxide), counter (Graphite) and reference (Ag/AgCl) electrode, respectively were used. The cathodic potential was optimized with help of cyclic voltammogram [1]. CdTe layers were electrodeposited at -0.7V. The influence of complexing agent and their optical, electrical, properties were studied. The deposited samples were annealed in ambient condition at temperature 450˚C for 20 min. The degree of crystallinity was found to be enhanced upon annealing. The prominent reflection peaks exhibited around 24°, 39° and 46° are corresponds to (111), (220) and (311) planes of cubic CdTe were obtained. The peaks in XRD spectra associated FTO substrate are marked as solid circle (*).The X-ray analysis of these films confirms the polycrystalline nature of prepared films having cubic crystal structure. The optical studied performed using U-Vis spectroscopy estimated band gap ~ 1.45 eV. The Schottky junction of Cadmium telluride was prepared using Au metal contact. The barrier height, and ideality factor was determined by using current-voltage characteristics and the carrier concentration and flat band potential were studied with capacitance-voltage measurement [2]. The ideality factor values found to be greater than the unity. The schottky barrier height increases with increasing concentration of citric acid due to current transport across the Au/n-CdTe interface. The slope of the Mott schottky plot is used to determined carrier concentration and flat band potential. The inversion, depletion and accumulation region are observed in all plots, inversion and depletion region are related to the depletion charge carries whereas accumulation is related to diffusion charge carrier. After annealing carrier concentration is found to be 1.72×10^{20} $cm^{-3}$to 2.67×10^{20} cm^{-3}[3].

Keywords: Cadmium telluride (CdTe), Electrodeposition, Thin films, Characterization.

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PP - 03

Cobalt oxide nanoparticles grown using SILAR method for oxygen evolution reaction and ethanol electrooxidation

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Abstract

Cobalt oxide nanoparticles were grown on graphite substrate using a simple chemical method namely successive ionic layer adsorption and reaction (SILAR). Cobalt oxide nanoparticles were grown using cobalt chloride ($CoCl_2$) and sodium borohydride ($NaBH_4$) as the precursors. Various SILAR parameters such as reduction time, number of SILAR growth cycles and $CoCl_2$ concentrations varied the size, shape and coverage of cobalt nanoparticles and thereby their electrocatalytic activity. The grown cobalt oxide nanoparticles were characterized for their structure by using X-ray diffraction. The size and coverage of the cobalt nanoparticles were observed using field emission scanning electron microscopic images. The grown cobalt oxide nanoparticles were electrocatalytically active and their activity and electrochemical stability were investigated with the help of cyclic voltammetry measurements done in aqueous alkaline electrolyte solutions. The cobalt oxide nanoparticles grown using SILAR are active catalysts for oxygen evolution reaction. They also show considerable activity towards ethanol electrooxidation reaction. The ease in preparation of metal oxide nanoparticles and their effective size, shape and coverage tuning due to number of process parameters provides an alternative interesting way of growth of catalytic cobalt oxide nanoparticles.

Keywords: Cobalt oxide, nanoparticles, successive ionic layer adsorption and reaction, ethanol electrooxidation, oxygen evolution reaction.

PP - 04

Single step rapid synthesis of metastable β-Bi2O3 nanoparticles using DC- Transferred arc thermal plasma route

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Abstract

Thermal Plasma gas phase condensation of nanoparticles is one of the renowned technique for nanoparticles synthesis [1]. There is observation of different polymorphs synthesis of oxides [2] and different morphology tuning [3] using DC-Thermal plasma route. The plasma operating parameters such as ambient pressure, plasma forming gases and operating power of plasma plays important role in tuning of phases of nanoparticles.

Here, we report single step synthesis of metastable β-Bi2O3 in rapid manner using DC-Transferred arc plasma synthesis. β-Bi2O3 has shown excellent photocatalytic activity as compared to other polymorphs of bismuth oxide namely α-phase (monoclinic low temperature stabilized) [4]. The X- Ray characterization technique ensures the formation of pure and highly crystalline β-Bi2O3. The surface analysis of polycrystalline β-Bi2O3 was carried using XPS analysis. From the UV-Vis spectroscopy the band-gap of material was 2.19eV which is in close agreement with other literature [5].

Keywords: Thermal Plasma, Bismuth oxide, Photocatalyst

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PP- 05

Nitrogen doped carbon quantum dots as electrochemical glucose sensor

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Abstract

A highly fluorescent nitrogen doped carbon quantum dots (N-CQDs) were synthesized via hydrothermal. The as synthesized N-CQDs are characterized by using UV-Visible spectroscopy, Fourier transform spectroscopy (FTIR) and X-ray diffractogram(XRD). UV-visible spectroscopy results revealed that decrease in the band gap of N-CQDs compared to CQDs. Fourier Transform Infrared Spectroscopy(FTIR) confirms the presence of nitrogen and carbon functional groups in the sample. X-ray diffraction(XRD) study revealed that presence of amorphous phase of carbon. The electrochemical cyclic voltammetry and chronoamperometric experiments are used to evaluate the electrocatalytic activities of the electrodes for glucose sensing application. The cyclic voltmmetry measurements data showed that electrocatalytic oxidation peak current of N-CQDs and it increases with addition of glucose in the range of 1mM to 5mM suggesting N-CQDs as a promising candidate for fabricating sensors for the quantification of glucose.

Keywords: Carbon quantum dots; Nitrogen; Doping; glucose sensing;

PP - 06

Non-enzymatic glucose sensor using GO/CuO nanocomposite

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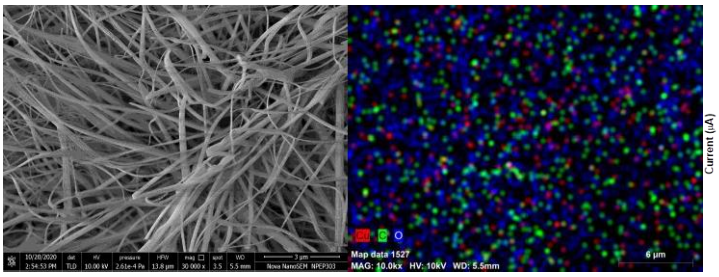
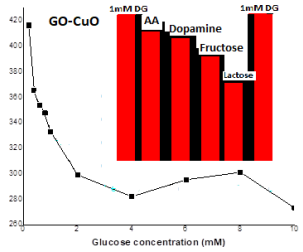
Abstract

A nonenzymatic electrochemical glucose sensor was fabricated using nano composite of Graphene oxide and copper oxide (GO/CuO). Structural morphology of nanocomposites was characterized using, XRD, FSEM, UV, FTIR and Raman spectroscopy. The GO/CuO nanocomposite was dispersed in DI water and drop casted on desired working area(1cm2) of FTO substrate. The sensor showed good electrocatalytic activity for oxidation of glucose in alkaline medium with linear detection range of 0.2mM to 10 mM. The sensor exhibited an excellent sensitivity of 200.53 µA mM-1cm-2, good selectivity, fast response time (3s). The sensor showed strong reproducibility, and excellent stability with the lower detection limit of 0.2mM glucose concentration. Moreover, the sensor was resistant to the common interfering species such as ascorbic acid, dopamine, fructose, lactose. The sensor was used for the determination of glucose in human serum and the results obtained (average recovery rate 98.28%) were in well agreement with standard pathology laboratory in the hospital.





Keywords: GO/CuO nanocomposite ,glucose sensor

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PP-07

Y2SrAl2CaZr2O12 garnet phosphor doped with Ce3+ for white light emitting diodes

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Abstract

The indoor lighting needs CCT< 6000 K and CRI > 85 with warm white light characteristics [1]. To fulfill the aforementioned points, Y3Al2Al3O12 phosphors was used where Y3+ (dodecahedral) and Al3+ (tetrahedral) sites were replaced by Sr2+ and Ca2+, Zr4+, respectively. The garnet-type Y2SrAl2CaZr2O12 (YSACZO) phosphors with various doping concentrations of Ce3+ ions were synthesized via solid state synthesis method. The compatibility of YSACZO:Ce3+ phosphors was demonstrated in detail for the application in WLEDs. The formation of garnet structure was clearly observed from the XRD studies. The present phosphor emitted greenish yellow emission peaking at 530 nm by absorbing blue light of 420 to 460 nm. The greenish yellow emission was due to the 5d-4f transition of Ce3+ ions [2]. The thermal stability of photoluminescence emission of YSACZO:Ce3+ was also investigated at 300 to 480 K. The mechanism behind high thermal stability of garnet phosphor is shown through Fig. 1. Commercial red β-SiAlON phosphors blended with YSACZO:Ce3+ and coated on blue emitting LED chips to fabricated white light emitting diodes (WLEDs). The electroluminescence spectra of the fabricated WLEDs exhibited pure white chromaticity with high CRI and low CCT. The spectral characteristic results indicated a promising garnet phosphor for blue excited white light emitting diode applications.

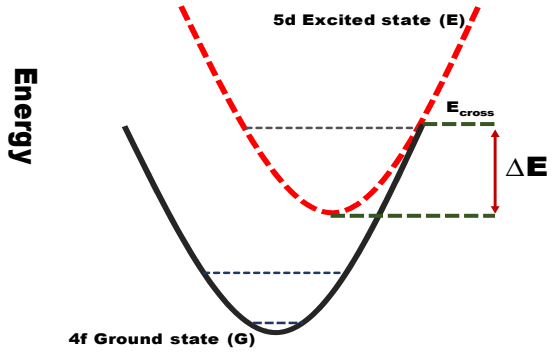

Figure: Schematic illustration of the configuration coordinate diagram and activation energy

Keywords: Phosphor; Garnet; Luminescence; WLED

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PP-08

Synthesis and Characterization of CdTe nanostructure by using Simple and low-cost Chemical Colloidal method

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Abstract

II-VI semiconductor compound CdTe is the most attractive for photovoltaic and high energy sensor applications because of their suitable optical and electrical properties. CdTe has a potential to fabricate high efficiency solar cell by means of low-cost technologies. In the present work we have synthesized CdTe nanostructures by using simple and low-cost chemical colloidal method. CdAc and TeO2 were used as Cd and Te precursors, respectively were dissolved in aqueous media (double distilled water) in presence of NaBH4, which acts as reducing agent. The reaction was carried out at temperature 800 C. The synthesized nanostructures were characterized to study optical and structural properties. The UV-VIS spectroscopy analysis estimated that the band gap of as-synthesized sample was 1.42 Ev [1, 2]. The XRD studies revealed that synthesized CdTe sample have a cubic crystal structure [1, 2]. The Raman microscopy studies shows the presence of longitudinal optical mode and their second, third order mode which indicate that good crystalline quality of CdTe nanostructure [2, 3].

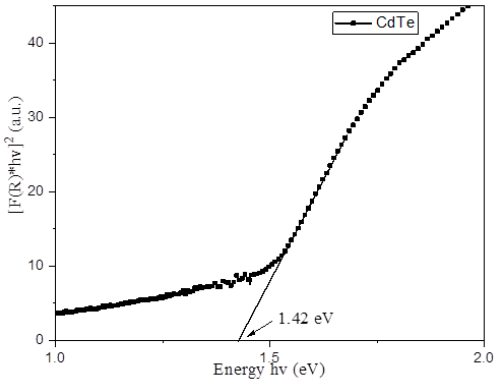

Figure: Tauc Plot for band gap estimation from diffuse reflectance spectra of CdTe nanostructure.

Keywords: CdTe nanostructure, Colloidal method, Optical properties, X ray diffraction, Raman Microscopy.

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PP-09

LI-FI WIRELESS COMMUNICATION

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Abstract

Li-Fi stands for Light Fidelity. The technology is very new and was proposed by the German physicist Harald Haas in 2011 TED (Technology, Entertainment, Design) Global Talk on Visible Light Communication (VLC). Li-Fi is a wireless optical networking technology that uses light emitting diodes (LEDs) for transmission of data. The term Li-Fi refers to visible light communication (VLC) technology that uses light as medium to deliver high-speed communication in a manner similar to Wi-Fi and complies with the IEEE standard IEEE 802.15.7. The IEEE 802.15.7 is a high-speed, bidirectional and fully networked wireless communication technology based standard similar to Wi-Fi's IEEE 802.11. This paper focuses on Li-Fi, its applications, features and comparison with existing technologies like Wi-Fi etc. Wi-Fi is of major use for general wireless coverage within building, whereas Li-Fi is ideal for high density wireless data coverage in confined area and especially useful for applications in areas where radio interference issues are of concern, so the two technologies can be considered complimentary. Li-Fi provides better bandwidth, efficiency, connectivity and security than Wi-Fi and has already achieved high speeds larger than 1 Gbps under the laboratory conditions. By leveraging the low-cost nature of LEDs and lighting units, there are lots of opportunities to exploit this medium. Li-Fi is the transfer of data through light by taking fibre out of fibre optics and sending data through LED light bulb. The aim of this project was to produce a functioning, 'proof of concept' prototype that utilizes VLC technology to send information to a related device across free space. The prototype should be low cost, compact and simple to implement.

PP-10

Annealing induced Ni+2 rich beneficial modification of α-Fe2O3/Ni1+xFe2xO4 nanoparticles

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Abstract

α-Fe2O3/Ni1+xFe2-xO4 binanoparticle (x = 0.05, 0.10) were synthesized by chemical method and subsequently annealed at various temperatures from 550 □C to 750 □C. The effect of annealing treatment on the structural, microstructural and optical band gap was investigated by XRD, RAMAN and UV-Visible spectrometer. XRD results indicate the formation of binanoparticle system with the presence of both NiFe2O4 and α-Fe2O3 phases. The ratio of phase fraction of NiFe2O4 to that of α- Fe2O3 increases upon annealing from 5 to 6 % for x = 0.05 sample and 3.31 to 11 % for x = 0.10 sample. The crystallite size of both the phases increases with increasing annealing temperature for higher Ni+2 content samples. However, the most dominant phase observed is NiFe2O4 which is further confirmed through Raman studies. The band gap of x = 0.05 samples annealed at various temperatures calculated from UV-Visible spectra is approximately 1.62 eV. The band gap of α-Fe2O3/Ni1.05Fe1.95O4 is not affected significantly with annealing temperature. However; the band gap of x = 0.10 samples increases from 1.62 to 2.55 eV with increasing temperature from 550 to 750 ºC. These finding signifies that α-Fe2O3/Ni1.05Fe1.95O4 may be useful in constructing anode material for water splitting application.

PP - 11

Ruthenium Sulphide Sensitized Titania electrode and theirApplication in Solar Cell

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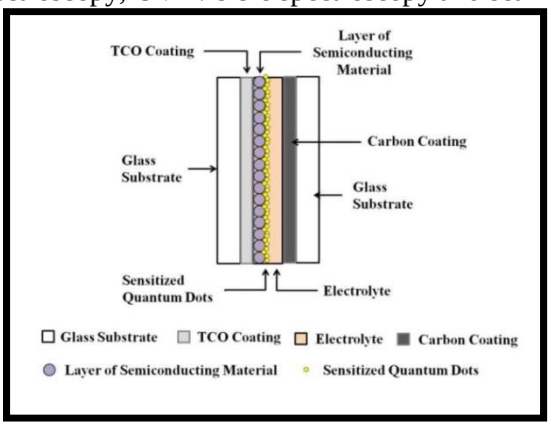
Abstract

Quantum Dot Sensitized Solar Cells (QDSSC) are the third generation excitonic solar cell, which acquired popularity due to their ability to replace Dye Sensitized Solar Cells (DSSC) due to projected photo conversion efficiency up to 44%. The present work is based on SILAR deposition of Ruthenium Sulfide films on conducting fluorine doped tin oxide (FTO) substrate. Titania films has been prepared by Doctor Blade method.The structural, optical and morphological properties were studied by using X-ray diffraction, RAMAN spectroscopy, UV- visible spectroscopy and scanning electron microscopy.



Here we report study on solar cell fabricated by using SILAR deposited Ruthenium Sulphide sensitization onto Titania photoelectrode. Porous morphology plays important role in QDSSC for the absorption of QDs. The influence of various SILAR cycles of Ruthenium Sulfide sensitizers on the light harvesting ability of the Titania photoelectrode and its subsequent highest power conversion efficiency for fabricated QDSSC were investigated.

Acknowledgement: Authors are thankful to DST-SERI New Delhi for partial financial support under the major research project scheme no. DST/TMD/SERI/S173(C).

PP - 12

Effect of TiO_2 Blocking Layer on Efficiency Improvement of dye Sensitized Solar cell

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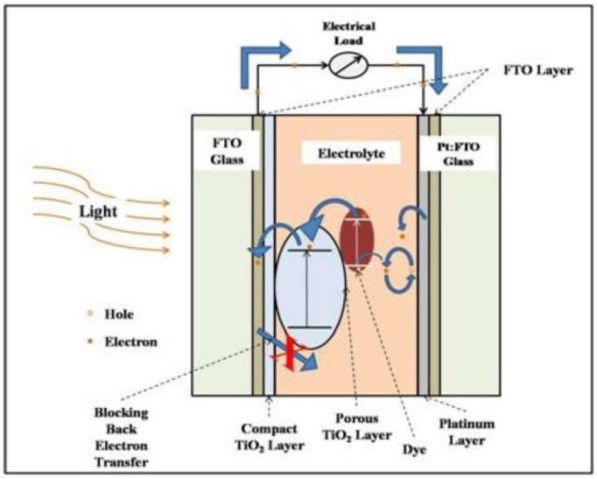
Abstract

A TiO_2 blocking layer provides good adhesion between Fluorine doped Tin Oxide and active layer of TiO_2. It is used to improve the performance of Dye Sensitized Solar Cell as it reduces electron back transport between electrolyte and FTO by blocking direct contact. The thickness of Titanium Dioxide blocking layers on FTO plays critical role in their performance. The aim of the study is toprevent back-reaction routes as shown in figure and to examine the ability of blocking layers to prevent or reduce losses that arise from electron transfer via substrate.



The prepared blocking layer will be characterized by electrochemical impedance spectroscopy which will study distribution of surface states at the titanium dioxide electrolyte interface. Further Open Circuit photovoltage Decay gives the information about the influence of the blocking layer on the back transfer of electrons to Tri-Iodide ions in electrolyte based dye sensitized nanocrystalline cell. The effect of thickness of TiO2 blocking layers on transmittance will be studied by UV- visible spectroscopy. The morphology and crystalline structure of TiO2 blocking layers will be characterized by scanning electron microscopy.

Acknowledgement: Authors are thankful to DST-SERI New Delhi for partial financial support under the major research project scheme no. DST/TMD/SERI/S173(C).

PP - 13

Visible light Photocatalyst for Water splitting, Dye Degradation and self-cleaning applications

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Abstract

In the development of new energy sources, hydrogen is one of the most attractive fuels for the 21st century. Hydrogen has considerable potential as an alternative fuel, especially if it can be generated inexpensively from an abundant raw material such as water. However, the efficient photocatalytic splitting of water to generate hydrogen using sunlight remains an as yet unachieved goal from a technological standpoint. A number of modification techniques and chemical additives have been developed in recent years to improve photocatalytic activity of Photocatalyst (e.g. TiO_2, ZnO) under visible light irradiation. Presently, we can directly use the visible light driven Photocatalyst like, $BiVO_4$, $MoSe_2$, $BiWO_4$ materials for the hydrogen production [1,2]. The development of better catalysts, tailoring of electronic structure and the reactivity as well as synthetic methods can be employed for controlling the morphology of catalysts. It is also going to benefited from recent progress in nano science. In this section we interested to synthesize the $BiVO_4$, $MoSe_2$and their composite for production of hydrogen through water splitting reaction.

Clean water is one of the most important natural resources for human, animals andplants in the world. With the rapid development of industries like chemical, petrochemical, pharmaceutical, mining, semiconductor and microelectronic, around the world the need for pure water as well as purification of contaminated water has increased. Each of these industries requires large quantity of water for processing and subsequently water discharged from them are contaminated with toxic organic pollutants. In addition, the increasing population of the world is also escalating the need of pure water for domestic purpose. The high population density and the level of industrialization have triggered the hydrosphere to be polluted with inorganic and organic matter with an increasing rate. Decades of untreated obnoxious waste disposed off in the land have created a serious ground water contamination problem due to metal leaching in water. Remediation of such a contaminated soil is an expensive process and it is highly unlikely that developing countries will have enough resources to ensure sufficient clean water reserve

Keywords: Photocatalyst, Photodegradation, Self cleaning.

Acknowledgement: The author is thankful to Radhabai Kale Mahila Mahavidyalaya, Ahmednagar for encouragement and support.

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PP – 14

Cluster radio shock and the Revived AGN fossilplasma source discovered in low-mass galaxy cluster PSZ2G111.75+70.37

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Abstract

We report the discovery of a Cluster radio shock (radio relic), 830 kpc in length, and found towards the outskirts of galaxy cluster PSZ2G111.75+70.37 (Abell 1697 at z = 0.181), using the LOFAR Two Meter Sky Survey at 144 MHz and uGMRT at 400MHz. An X-ray-inferred mass of M500 = 2.9 0.75times1014M places Abell 1697 among the least massive relic hosts. The relic is also detected at 325 MHz in the Westerbork Northern Sky Survey and at 1.4 GHz in the NRAO VLA Sky Survey, with an average spectral index of (144, 325, 1400 MHz) = 0.98 ± 0.01, and magnetic field of Beq 0.6µG. This relic, located in the north-east periphery of the cluster, is 300 kpc wide, exhibits a gradual spectral steepening across the width (from 0.70 ± 0.11 to 1.19 ± 0.15), as well as indications of a co-spatial X-ray (ROSAT) shock and the radio relic emission. The radio power of the relic is P1.4GHz = 8.5 1.1 1023WHz1 , which is found to be in good agreement with the expected empirical correlation between the radio power and largest linear size of relics. The relic is trailed by extended (790× 550 kpc) diffuse radio emission towards the cluster centre, which is likely an ultra-steep spectrum (¡ 1.84) radio source. This structure is also found to be older by at least 190 Myr, has a very low surface brightness of 0.3µJyarcsec^2 and magnetic field Beq 0.8µG, similar to that of a radio phoenix. Finally, we discuss the possible mechanisms responsible for the relic and the trailing diffuse radio emission, invoking re-acceleration due to wake turbulence, as well as the revival of fossil electrons in the remnant radio lobes of active galactic nuclei by the cluster merger shocks.