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1. Introduction to NNfC Capabilities: **Dr. Savitha P, CeNSE, IISc, Bengaluru, Karnataka**

National Nanofabrication Facility (NNFC) is a state-of-the-art cleanroom spanning over an area of 14,000 sq ft. This multiuser facility is a national facility open to students from all over India, as well as for private industries, public sector undertakings and Indian Strategic sector. The facility caters to a wide range of technologies including MEMS/NEMS, photonics, spintronics, PV, sensors, actuators and material development. This talk has mainly two parts: First part is a general overview of a cleanroom, including identification of common contaminants and how to protect the cleanroom from the same. The second part details the capabilities of NNFC cleanroom.

2. Introduction to MNCF Capabilities: Dr. Suresha S J, CeNSE, IISc, Bengaluru, Karnataka

MNCF is a 5000 sq. ft facility with precision controlled environment and Facility operates 24 X 7. MNCF offers a wide variety of material and device characterization services enabled by the more than 35 pieces of equipment housed in four characterization bays as Electrical Characterization, Mechanical Characterization, Material Characterization & Optical Characterization. We also network with other external laboratories to enhance breadth of our services. More than 1000 researchers of IISc use MNCF characterization services regularly and work with MNCF Technologists on various academic/industrial R&D problems. We recognize that the quality and accuracy of scientific results are of the highest significance in research. We therefore strive to ensure that our equipment are in fine shape always and that they are calibrated periodically by using traceable standards.

3. Embedded ring fabricated using silica etch mask: Viswas Sadasivan* and Utpal Das, Electrical Engineering, IIT Kanpur , Kanpur, U.P. 208016.* Currently with Department of Electronics and Communication, Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, Kerala, 690525, viswassnair@am.amrita.edu, viswassadasivan@gmail.com

Embedded rings(ER) with ring inside a ring geometry [1], [2] provides interesting spectral features with applications to high speed electro-optic[2] and all-optical [3], [4] modulators or switches. They have small foot print, strong field interaction with waveguide media and a sharp roll-off in the spectrum. Initially ER have been proposed in Si [1] , but their electro-optic modulation application was limited by free carrier transit times. The device being studied uses high electro optic and nonlinear coefficient of InGaAsP/InP MQW [2], [3].

The device is fabricated in InGaAsP/InP heterostructures. Here, the InGaAsP/InP MQW acts as the waveguiding core and InP is the substrate. The waveguide etch depths required is ~4.5□m into the InGaAsP/InP, with low etched surface roughness. This necessitates a high-quality metal/dielectric etched mask. The overall device dimension on chip is ~300x300 □m 2 , and the smallest feature size is 100nm coupling gap separating a 200nm wide tapered waveguide and 500nm wide bent waveguide.

Embedded rings fabricated using EBL and Al lift-off mask suffered large side wall roughness. This prevented a direct measurement of the ring's spectrum as it was marred by higher order modes produced due to mode conversion at rough interfaces. An improved process has been optimized to reduce the side wall roughness caused by lift-off, by using an etched SiO 2 mask. Additionally, anti- reflecting subwavelength grating structures have been fabricated at the input and output waveguide facets to enhance the coupling coefficients. Process optimization for SiO 2 etched mask involved finding the etch selectivity for the EBL resist ma-N-2401 to Cr and, etch selectivity and side wall angle in SiO 2 etch using Cr mask. The mask defects were corrected using focused ion beam milling and deposition before transferring the pattern to actual InGaAsP/InP heterostructure. Elaborate process optimization for EBL and CH 4 +H 2 RIE of InGaAsP is presented elsewhere[5].

High levels of surface smoothness have been observed in SEM images of the fabricated device. The through port and drop port spectra have been measured for the 5□m outer ring radius device and matched with simulation.

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References:

[1] L. Zhang, M. Song, T. Wu, L. Zou, R. G. Beausoleil, and A. E. Willner, "Embedded ring resonators for microphotonic applications," Opt Lett, vol. 33, no. 17, pp. 1978–1980, Sep. 2008.

[2] V. Sadasivan and U. Das, “QCSE Tuned Embedded Ring Modulator,” Light. Technol. J. Of, vol. 32, no. 1, pp. 107–114, Jan. 2014.
[3] V. Sadasivan and U. Das, “Optical switching in InGaAsP/InP Embedded Ring Resonators,” in 12th International Conference on Fiber Optics and Photonics, Kharagpur, India, 2014, p. M4A.30.
[4] V. Sadasivan and U. Das, “Nonlinear tuning in InGaAsP Embedded Rings,” Opt. Quantum Electron., vol. 50, no. 2, p. 76, Jan. 2018.
[5] V. Sadasivan, S. Dagar, and U. Das, “Fabrication of low grass, smooth sidewall InGaAsP by Methane-Hydrogen ICP RIE through a metal lift-off mask patterned by e-beam lithography,” J. Vac. Sci. Technol. B, vol. 33, no. 5, p. 051210, Sep. 2015.

4. Cleanroom Case Studies: Dr. Vijayaraghavan, CeNSE, IISc, Bengaluru, Karnataka

NNFC is a class 100 and class 1000 state-of-the-art Semiconductor fabrication facility enabling More-Moore and More than-Moore technologies including MEMS/NEMS, photonics, PV, spintronics, sensors, actuators and materials development. Supported by 24/7 cleanroom utility and dedicated staff members, NNFC is capable of realizing micro and nanoscale devices on various substrates that include Si, GaN, SiC, Quartz, Glass, Graphene and III-V semiconductors. In this talk I will discuss various process capabilities that we have developed and explore the possibilities to realize devises by giving some examples.

5. Focused Ion Beam - Capabilities & Applications: Ms. Suma B N, CeNSE, IISc, Bengaluru, Karnataka

The frontier of today’s scientific and engineering research is undoubtedly in the realm of nanotechnology: the imaging, fabrication, and application of systems at the nanometer scale.The ability to conduct material fabrication via precise micro- and nano-machining has become imperative to the progress of materials science and other fields relying on nanotechnology.
An important tool that has successfully met these challenges and promises to continue to meet future nanoscale demands is the focused ion beam (FIB) system. The technology offers the unsurpassed opportunities of direct micro and nano-scale deposition or materials removal anywhere on a solid surface. The focused ion beam (FIB) system is an important tool for understanding the structure of materials at the nanoscale. Combining this system with an electron beam creates a Two Beam system – a single system that can function as an imaging, analytical, and sample modification tool.

6. Nanomaterials and Nanostructures: Prof. S A Shivashankar, CeNSE, IISc, Bengaluru, Karnataka

Nanomaterials and structures have been the focus of much effort in recent years because they exhibit features that make them attractive to numerous applications. The talk will highlight the various aspects of nanomaterials and how they may be utilised.

7. Microfluidics for Biological Applications: Prof. V Venkataraman, Dept. of Physics, IISc, Bengaluru, Karnataka

Microfluidics refers to the manipulation of fluids in nanoliter or microliter volumes using microfabricated silicon, glass or polymer devices. The fluids are typically chemical or biological samples, and the microfluidic devices can process these samples using much smaller volumes when compared to bench-top systems without degradation in performance. This improves the efficiency and lowers the processing cost. Apart from liquid samples, more complicated biological structures such as cells or even whole micro-organisms can be analyzed at the micron scale. The most common prototyping material used for the fabrication is poly-dimethyl siloxane (PDMS), a soft and transparent polymer. In this talk, we demonstrate several examples of PDMS devices fabricated in our laboratory including a sealed micro-reservoir for DNA amplification using PCR, electrowetting actuated droplet motion, microfluidic flow cytometry and microfluidic devices for trapping and studying forces exerted by C. Elegans nematode organisms.

8. MEMS Sensors: Prof. Rudra Pratap, CeNSE, IISc, Bengaluru, Karnataka

The world of sensing is undergoing an unprecedented revolution. The advent of miniaturization of sensors because of MEMS technology has led to an explosion in the use of sensors and sensing technology. The biggest civilizational change in human history is looming large over us in the form of IoT and IoT depends squarely on MEMS and NEMS sensors.

While the world of sensing is huge, I will focus on a slice of MEMS sensors in this talk, in particular, vibratory MEMS sensors. The interplay between inertia and elasticity results in mechanical vibrations in any system at almost all length scales. These vibrations can be used as probes for the internal structure of the system as well as its immediate external world. This fact is what we exploit in the design of all vibratory MEMS and NEMS devices. Mechanical vibrations come in two flavours—natural and forced. Natural vibrations of a system contain a wealth of information about the internal structure of the system and can, therefore, be very effectively used to probe even minute internal changes. Our ability to accurately measure such vibrations at extremely small length scales has opened up the possibility of sensing molecules without chemical analysis and probing the internal structural changes in cells in response to pathologies. The forced vibrations of small scale systems, on the other hand, can be effectively used to probe the external world at small length scales with transmitted and reflected disturbances. I will present several examples of 1D, 2D, and 3D structures—both from the world of MEMS/NEMS and natural insects (inspiration for MEMS)—where extremely small scale vibrations (with amplitudes ranging from tens of picometers to several nanometers) are exploited for probing and sensing

9. Nanosensors for Defence Application: Prof. R Muralidharan (Ex. Director SSPL), Emeritus Faculty, CeNSE, IISc, Bengaluru, Karnataka

Physical (temperature , pressure ,electromagnetic, inertial guidance etc) , Chem-Nuclear-biological-Explosive sensors are required for defence applications. The basic principles of sensors and the need to miniaturise the same will be discussed in detail. Fundamentals of Infrared detectors and UV detectors will be discussed. Brief details of research being carried out in CENSE and possible opportunities in the area of UV detectors will be presented.
The modern soldier is called a soldier as a system and he carries all kinds of sensors and communication equipments which need energy back -up. The need for research in the area of energy generation and storage will be discussed and the possible applications of nanotechnology will also be given.

10. X-ray Photoelectron Spectroscopy: Mr. Varadharaja P, CeNSE, IISc, Bengaluru, Karnataka

X-ray Photoelectron Spectroscopy (XPS) is an extremely surface sensitive non-destructive technique that provides quantitative surface chemical state information for all elements except hydrogen and helium. The session covers some basic knowledge of XPS, why XPS technique is surface sensitive? Chemical shifts, angle resolved XPS, small area XPS, XPS Imaging and depth profile XPS.

11. Magnetic Nanoswimmers for Biotechnology: Successes and Challenges: Prof. Ambarish Ghosh, CeNSE, IISc, Bengaluru, Karnataka

The idea of tiny vessels roaming around in human blood vessels working as surgical nanorobots was first proposed by Richard Feynman, a vision that has triggered imagination in scientists and non-scientists alike. With current advances in nanotechnology, there have been several strategies to realize this dream of a "nanovoyager", which is of both fundamental and technological interest. My talk will focus on a system of artificial helical nanostructures that can be actuated with small magnetic fields to move through fluidic media in a highly controllable fashion, share the recent promising results pertaining to biotechnology and describe the many challenges that lie ahead.

12. Role of Organic Dopants in Tuning Selectivity of Conducting Polymer functionalized Carbon Nanotubes Network(s) for detection of Volatile Organic Compounds (VOCs): Aruna P. Maharolkar*, Kunal P. Datta, Marathwada Institute of Technology, Aurangabad-431001, M.S. , India, DDUKK, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad-431001, M.S., India

Environmental pollution is alarmingly looming large on natural existence and considered among most challenging problems of the hour. The air we breathe has become a matter of serious concern, especially in South East Asian countries. Financial insolubility and ill- awareness of a large mass of population is this part of Earth is continually adding up innumerous pollutants in air and volatile organic compounds (VOCs) constitute a major part. As every other household commodity is a potential source of VOCs, indoor air, now a day warrants serious attention. Members of VOCs family, being very large in number and many of them bearing similar physic-chemical properties, are hard to be identified distinctively.
This work reports an attempt to fingerprint Methanol distinctively with Polyaniline (PANI) functionalized Multi Walled Carbon Nanotubes (MWNTs). The point of interest of investigation lies with role of dopant being utilized while functionalizing MWNTs with PANI. It has been observed that dopnats can be judicially applied for tuning selectivity of such structures. The optimized sensor exhibited 4.2% sensitivity with excellent linearity ($R^2 = 0.997$) within validation

window of 05 to 40 ppm while a sensitivity factor of 31.3% with linearity factor of 0.987 was recorded for a concentration window of 0.5 to 3.00 ppm . Response and recovery signature of the sensors were clear. Most prominently, the sensor was able to distinguish methanol in contrast to other members of alcohol family viz. ethanol and propanol.
As methanol is a hazardous VOC with long term and/or immediate health effect of human as well as animal species, real time detection of methanol vapour, qualitatively/ quantitatively is important. In this context, the present investigation constitutes an imperative step.

13. Microwave Magnetics: Enabling 5G and more: Dr. Ranajit Sai, CeNSE, IISc, Bengaluru, Karnataka

In the age of internet of things (IoT), millions of connected devices are poised to transform our lives by saving energy, reducing pollution, and thus making life more sustainable. The imminent 5th generation of telecommunication systems is going to be the key foundational technology to accomplish the potential of IoT. The continued miniaturization of high frequency devices amidst strict performance criteria often called for innovation in the design as well as in the materials used to make the devices. In this regard, magnetic materials play a huge role to overcome technological bottlenecks of high frequency devices.
The central theme of this talk is to delve in 'new magnetics design' to solve technological bottlenecks of high frequency passive devices. Two case studies describing GHz inductors and electromagnetic noise suppressors will be presented. The future outlook of such magnetic devices will also be discussed briefly.

14. Sensors to Systems: Prototype making at CeNSE: Dr. Vijay Mishra, CeNSE, IISc, Bengaluru, Karnataka

The talk will give overview of practical challenges involved in making systems around Nano technology based sensors. For making prototypes with quick turnaround time, in-house facilities and expertise needs to be available at arm's length. We, at CeNSE, have made infrastructure to build hardware and firmware modular libraries to enable building product prototype quickly. Case studies of enabling proof of concepts and making products for possible technology transfers will be discussed in this talk.

15. FTIR: Dr. Arun Babu, CeNSE, IISc, Bengaluru, Karnataka

Fourier-transform infrared spectroscopy is a method of infrared spectroscopy. When IR radiation is passed through a sample, some frequencies are absorbed by the sample and some are transmitted. The resulting spectrum representing a molecular 'fingerprint' of the sample can be used to identify the chemical structure of the sample.

16. Nanoscale Characterization: Understanding materials' behaviour at the fundamental level: Dr. Swarnagowri Addepalli, CeNSE, IISc, Bengaluru, Karnataka

Devices used in various applications (semiconductor industry, solar, spintronics) are becoming increasingly complex in their composition and construction, with multilayered structures and dissimilar interfaces, in order to satisfy the demands of increased speed/efficiency/throughput and so on. The fabrication and processing of these devices is also equally complex, involving a multitude of steps. Any impurities or compositional changes can significantly affect the performance and reliability of the devices. This places very stringent demands on metrology and quality control, as well as a need to thoroughly understand the behavior of the various materials that are used in the devices, their stability, as well as their response to the environment in which they will be used.
This talk will provide a brief overview of some advanced nanoscale materials characterization techniques, and how they can be applied to understanding the interactions between different types of materials and interfaces, as well as for failure analysis.

17. Ultrasonic Characterisation of Pr-substituted $BaFe_2O_4$spinel ferrites: E. Ahilandeswari, K*. Sakthipandi and M. Sivabharathy Department of Physics, Sethu Institute of Technology, Kariapatti 626 115 Tamil Nadu, India

In recent years, spinel ferriteshave become a centre of scientific investigationsbecause of their potential applications in many areas, which include power conditioning, electronics, bioprocessing, and magnetic resonance imaging enhancement. The higher values of electrical resistivity and low eddy current losses make these spinel ferrites suitable for the applications at microwave frequencies without eddy current losses. Potential applications of barium spinel ferrites is improved by introducing some small amount of rare-earthions into the interstitial sites. The ferrites substituted with rare-earth elements cause the change in structural/microstructural and magnetic properties due to change in structural spins and strains in

material. Ferrites are compounds of iron oxides with the general formula of $M^{2+}Fe_2^{3+}O_4^{2-}$ where M^{2+} is a divalent metal ions.The magnetic properties of these spinel ferrites are governed by the Fe–Fe interaction i.e., spin coupling of the 3d electrons. The doping of rare-earth ions into the spinel lattice leads to interactions between rare-earth and Fe ions. Hence, a coupling (3d–4fcoupling) is appeared leading to change in the magnetic behaviour of the ferrites. In this study, an investigation was made on the praseodymium substituted $BaFe_2O_4$spinel ferrites. $BaFe_2O_4$, $BaPr_{0.05}Fe_{1.95}O_4$ and $BaPr_{0.10}Fe_{1.90}O_4$ spinel ferrites were prepared by using sonochemical reactor. The X-ray diffraction peaks strongly reveal that the prepared nanoferrites have cubic structure. It is observed that the diffraction peaks become lower and broader due to the addition of praseodymium ions. Crystallite size of the sample lies within the range of 50 nm to 37 nm. The lattice constant of the unit cell obtained from X-ray diffraction peaks increases with an increase in concentration of Pr ions. This increase in the lattice constant is attributed due to the larger ionic radius of Pr^{3+} ions as compared to that of Fe^{3+} ions. SEM images of the prepared ferrites showed that ferrites exhibited a dense arrangement of homogeneous nanoferrites with spherical shape, which were also cleft free. The increasing concentration of Pr^{3+} ions reduces the grain growth probably due to segregation on or near the grain boundaries. The evaluation of this interaction between rare-earth and Fe ionscan be obtained by analyzing the Curie temperature or magnetization.Temperature-dependent normalized susceptibility were measured in the range of temperature from 300 to 650 K. A peakwas observed in Temperature-dependent normalized susceptibility at certain temperature (i.e., blocking temperature). After Blocking temperature, an abrupt fall up to zero in normalized susceptibility was observed. A relatively sharp fall of the magnetic susceptibility is a Curie temperature T_C.$T_C$for $BaFe_2O_4$, $BaPr_{0.05}Fe_{1.95}O_4$ and $BaPr_{0.10}Fe_{1.90}O_4$ is 592, 554 and 513 K. Further, the T_C was turned towards the lower temperature with increasing the concentration of praseodymium.

Keywords: spinel ferrites, X-ray measurement, Magnetisation, Transition Temperature

18. Prediction of Mixing Performance in Micro Channels using Neural Networks*:* Ajith R.R.* and S. Kumar Ranjith, College of Engineering Trivandrum, Thiruvananthapuram, Kerala

Keywords: Microfluidics, micro channels, fluid mixing, droplets, Neural Networks

Introduction: Microfluidics is the science and technology for manipulating minute quantities of fluid using micro channels [1]. When the microfluidic system for manipulation, analysis and visualisation are converged to a single miniature device, it is known as microfluidic chip. In comparison to the electronic chips, these devices are made of largely polymers or sometimes even silicon when considering the ease of manufacture or ease of integrating the electronic accessories to the microfluidic devices.

Mixing of fluids is one of the critical areas in which the microfluidics is focussed on [2]. The mixing phenomena of different fluids having tiny volumes and flow rates are rather unpredictable due to the various factors affecting the phenomena in a microscopic scale. The influence of many factors are substantial in the case of flow and mixing in a micro channels, which are insignificant in the case of macroscopic flows[3,4].

The present study focus on the fabrication of a micro- droplet mixer on a chip that is essentially a combination of micro channels for the mixing and droplet formation of three different fluids. The study also include the visualisation and analysis of the droplets formed and the prediction of the mixing performance of the system using artificial neural networks.

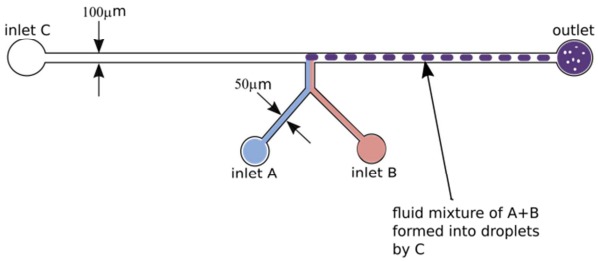


Fig.1 Schematic of proposed microfluidic droplet mixer.

The two main fluids A and B(ink and water for example) having different concentrations are introduced through the respective inlets and undergo mixing in the join as in Fig 1. The mixture then propagates to the wider main channel where it is introduced in to a continuous flow of fluid C at right angles. The fluid C, being immiscible with the water-ink mixture,

converts the mixture into droplets. These droplets can be visualised using a microscope at different distances from the joint and the mixing effectiveness can be found out. From the images captured at different lengths, it is possible to arrive at a conclusion about the distance for a definite mixing efficiency when the other controllable factors such as inlet flow rates, fluids etc are constant. The artificial neural networks can predict the mixing efficiency when variables like fluid viscosities, flow rates and distance of the channel are input.

References:

1. George M. Whitesides. The origins and the future of microfluidics. Nature, 442, July 2006.
2. Capretto L, Cheng W, Hill M, Zhang X (2011) Micromixing within microfluidic devices, vol 304. Springer, Berlin
3. C Jaimon, SK Ranjith, Numerical Investigations on Mixing in Microchannels with Transverse Hydrophobic Strips, Microsystem Technologies 23 (7), 2881-289

Hessel V, Löwe H, Schönfeld F (2005) Micromixers: a review on passive and active mixing principles. Chem Eng Sci 60(8):2479–2501

19. Exploring microbes for their potential beneficial applications using integrated application of metagenomics and nanotechnology: Anamika Dubey*, Ashwani Kumar*, Metagenomics and Secretomics Research Laboratory, Department of Botany, Dr. Harisingh Gour Central University, Sagar (M.P.) 470003, India, *Corresponding author; Ashwani Kumar (supervisor), Email id: ashwaniiitd@hotmail.com

Recent developments in the bioprospecting of microbes for producing industrially relevant products are gaining increased attention. Large number of products have been developed from the cultivable microbes in the laboratory, though most of them failed to deliver their promises under field conditions. There is an urgent need to develop the methods to extract more from these microbes under field condition, including the uncultivable microbes that constitute more than 95% of microbial diversity. The goal of our laboratory of metagenomics and secretomics is to explore this huge untapped microbial diversity from adverse environmental conditions for potential applications such as enhancing plant growth and health under stressed conditions, arbuscular mycorrhizal-invasive plants relation, weedy biomass hydrolysis, and bioremediation of contaminated environment. The application of next generation sequencing and bioinformatics software pipeline in our ongoing research unravel the taxonomic and functional diversity of microbes. Moreover the use of nanotechnology in developing microbial formulation would enhance their ability to survive and perform under drought stressed conditions for sustainable agriculture production.

Keywords: Metagenomics, Nanotechnology, Microbiome, Next generation sequencing

20. Titanium Dioxide Nano Particles Based Natural Dye Sensitized Solar Cells for Green Energy Harvesting: Ananth S*, KPR Institute of Engineering and Technology, Coimbatore, Tamil Nadu

The ever increasing demand for more energy is a serious issue faced by the present world. The solution for this crisis should be reliable, cheap and must be environment friendly. Solar energy is a crucial component of renewable energy probable as the solar energy flux reaching the Earth's surface represents a few thousand times than our need. For a tropical climate country like India, harvesting solar energy will be most significant. For this purpose, solar energy has to be converted into electric energy using the principle of photoelectric effect. Among the various types of solar cells, dye sensitized solar cell (DSSC) is an attempt to replicate nature's photosynthesis by combining a semiconductor metal oxide, a dye sensitizer, an electrolyte and conducting electrodes.And, the efficiency of DSSC depends on thesemajor components, design and fabrication processes. Hence, optimizing each component is essential to achieve maximum efficiency. There has been lot of researches going on to improve the efficiency of TiO_2 based dye sensitized solar cell by varying parameters like film thickness, changing the dye, electrode, different substrates, doping etc. In this work, we investigate the possibilities to improve the efficiency by choosing suitable metal oxide semiconductor (nanoparticle, nano tube), suitable new natural dyes and the conducting polymer based counter electrode. In short, except the liquid electrolyte, all other components were taken for research to reduce the cost per watt and to improve the efficiency.

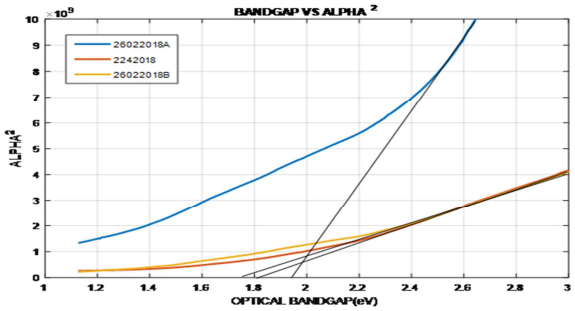
The synthesis of high quality, low cost TiO_2 nanoparticles by sol – gel method, spin coating and microwave assisted methods. The TiO_2 nanotubes were synthesized using chemical vapor deposition method (CVD) and via anodic alumina template. The solar light to electron conversion efficiency of these nanoparticles and nanotubes with synthetic dye (Ruthenium based) and natural dyes. Their performance with FTO and conducting polymer based electrodes were analyzed.

The ***natural dyes*** are available in nature in the form of plant bark, root, flowers, leaves, wood and fruit etc. Natural dyes are ecofriendly, biodegradable, less toxic to the environment and available in full range of colors. In DSSC, several natural dye pigments, such as porphyrins and phthalocyanines, chlorophyll, betanins, carotenoids, anthocyanins andtannins have been successfully used as sensitizers. The organic dye structure should contain several = O or – OH groups capable of chelating to the Ti sites on the titanium dioxide surface to give high efficiency.

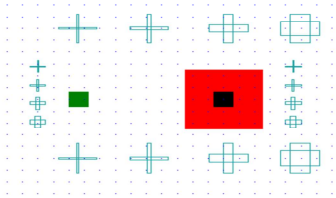
Owing to the high cost and advanced equipment requirement, a part of this research will be focusing on to develop conducting polymer based flexible electrodes. One such potential material for the synthesis of flexible polymer based transparent electrodes for DSSC is highly conducting PEDOT (poly (3, 4 - ethylenedioxythiophene) and its copolymers. Their sheet resistance will be reduced to improve the conductivity either by doping or by introducing current collecting silver and copper metal grids. The performance of these conducting polymers will be compared to that of FTO glass based electrodes for individual natural dye and synthetic dye. The performance with respect to TiO_2 nanoparticles and TiO_2 nanotubes will also be investigated.

21. Fabrication and Characterization of Defect induced ZnO/CuO Novel LED Heterostructures: Dr.Sudhakar.KB, Anitha.S*, Sri Venkateswara College of Engineering, Kancheepuram, Sriperambudur, Tamil Nadu

LEDs based on InGaN are the most commonly used material for domestic and defense applications. However, due to the high demand and scarcity of In, a replacement material for GaN is sought. ZnO is a promising alternative to GaN, with a similar wide bandgap energy and higher exciton binding energy (60meV). In addition to this, ZnO based thin films and devices can be fabricated by low cost synthesis methods (Sputtering, CVD and Evaporation) on cheap substrates. However, the major bottleneck in creating a device is the unavailability of stable p-ZnO, due to Zn interstitials and O vacancies.
The problem of p-type doping of ZnO can be overcome by choosing a suitable alternative material. Alternate material, CuO has been proposed in this paper, which is a native p-type material. An hetero-structure device built using ZnO-CuO will lead to its use in white-light applications. The native defects in the ZnO layers can be exploited to tune the bandgap of CuO, which can emit light ranging from violet to red.
The project will be fabricated using RF Sputtering method. The dry methods are preferred over wet methods for large scale production, stability and longer life time. RF magnetron sputtering technique, unlike other deposition techniques offers larger design space to produce high deposition rate, low temperature, low cost, stable and large-scale ZnO nanostructures, which are important for flat-panel displays (LEDs), optoelectronic and flexible electronic devices.
This proposal will focus on novel co-sputtering technique to deposit superlattice type periodic nanostructures of n-ZnO and p-CuO; employ appropriate annealing techniques; study the effects of native oxide defects, which will induce light emission at discrete wavelengths as well as coemission in visible spectrum. It is to be noted that there are no existing technologies available, which utilizes the defect induced emission in CuO/ZnO based heterostructures for industrial production to the best of our knowledge. The proposed study on defect induced light emission may pay way towards realizing and commercializing environmentally friendly, low cost, high performance LEDs.
Literature survey of different ZnO-CuO hetero-structures has been studied. The optimization of the RF Sputtering unit had been carried out and CuO thin films have been prepared as the initial step and the absorbance spectra of CuO thin films have been shown below.



The mask for the device has been designed and is shown below.



The device will be fabricated in the Interdisciplinary centre for Nanotechnology, Sri Venkateswara College of Engineering and the relevant characterization will be carried out. For this device, XPS,TEM, XRD and Photoluminescence will be carried out to study the device characteristics and structure.

22. Characterization Modelling and design of Ultra Low Power Modules for IOT Application: Anna Merine George*, Assistant Professor, Dayananda Sagar University, Bengaluru, Dr. S.Y. Kulkarni, Vice Chancellor, REVA University

Ultra low power techniques and power reduction has been the target of Wireless Sensor Nodes (WSN), Internet of Things (IOT), smart grids, implantable devices and datacenters and storage markets. Longer battery life, small form factor, higher performance and lower power consumption are the goals for future sensor nodes. Most IOT devices are active for a short amount of time and are in sleep or standby mode for a long time [1]. Therefore reducing the sleep-mode power consumption can significantly extend the overall battery lifetime. A nano-timer can play a major role in minimizing sleep current and managing the go to sleep, and wake up phases of a battery powered IOT node. Dynamic power consumption can be reduced by scaling the supply voltage [3]. However lowering the supply voltage affects the circuit speed which is the major short-coming of this approach. Thus an integrated approach that involves supply voltage scaling, pipelining and parallelism in system architecture, use of different power modes available in the device and power gating techniques are used to achieve higher performance at lower operating voltages.
Wireless Sensor nodes form an important part of IOT devices and integrates a power source, sensor unit, processing unit and communication unit. In order to reduce the energy consumption of the sensor nodes it is necessary to accurately estimate the energy consumption of the WSN using energy models implemented in QualNet and EXata emulator [4].
Shrinking of transistor size causes power management critical aspect of design flow. A Power aware design flow addresses the chip architecture, design, implementation and verification using a Common Power Format (CPF). Power optimizations at various design levels like software optimizations, architecture selection, Register Transfer Level (RTL) to Graphic Database system (GDS) implementation and process technology choices are a good strategy for power reduction. The choices made in the early development cycle at Electronic System Level (ESL) & RTL stage provide significant savings in power than power optimization in physical implementation phase. The selection of device structure (FINFET, planar) and device material (HiK, SOI) also play a critical role in power savings [2].
Systems require different power levels as they combine Intellectual Property from analog, digital and mixed signal vendors thereby necessitating efficient power management circuits. The emergence of wide band gap (WBG) power devices based on silicon carbide (SiC) and gallium nitride (GaN) hold promises of raising the ceiling of power converters.
Through this programme I would like to work on characterization of new device structures like FINFET, Schottky junction transistor and Graphene FET transistors to study the power aspect and the impact of Process, Voltage Temperature (PVT) Variations on FINFET chip performance and power.
References

1. Alioto, Massimo "Ultra –low power VLSI circuit design demystified and explained: A tutorial", *IEEE Transactions on Circuits and Systems I: Regular Papers* 59.1 (2012): 3-29.
2. Hiramoto, T., "Ultra– low power and ultra –low voltage devices and circuits for IOT applications", *Silicon Nanoelectronics Workshop (SNW)*, 2016 IEEE.
3. Nakai, Maskatsu, Satoshi Akui, Katsunori Seno, et al., "Dynamic Voltage and frequency management for a low power embedded microprocessor," *IEEE Journal of Solid State Circuits*, 40, no. 1 (2005): 28-35.

Korkalainen, Marko, Mikko Sallinen, et al., "Survey of wireless sensor networks simulation tools for demanding applications", *Fifth International Conference on In Networking and Services 2009 (ICNS)*, pp. 102-106, IEEE 2009.

23. Nd_2O_3/ZnO Dispersed Graphene Oxide Nano Composite for The Photo Catalytic Degradation of Ciprofloxacin Antibiotics under Visible Light Irradiation: M. Arunpandian*, K. Selvakumar, S. Arunachalam, Department of Chemistry, Kalasalingam Academy of Research and Education, Krishnankovil - 626126. Viruthunagar (Dt).

In our present scenario, Nd_2O_3-ZnO dispersed graphene oxide (NOZG) nano composites were synthesized by hydrothermal method, and it's characterization and investigation for the photocatalytic degradation of ciprofloxacin were reported. The resulting nano composites were characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction analysis (XRD), Scanning electron microscopy (SEM), Energy dispersive X-ray spectroscopy (EDX) with mapping. The optical properties were analyzed by UV-Vis and fluorescence techniques. The photocatalytic activity of the prepared NOZG nano composites has been investigated for the degradation of ciprofloxacin drug under visible light irradiation in aqueous solution of different conditions. The major influential factors such as NOZG dose, concentration of the organic pollutants (CIP-Ciprofloxacin), Different weight ratio of the catalyst, visible regions, reusability of the catalyst were

studied. The addition of radical scavengers (e.g: ethanol, triethanolamine, benzoquinone & isopropyl alcohol) on the degradation ability were studied.

24. Transparent Conducting Oxides for Photo Voltaics and Optoelectronic Devices: Balaprakash V*, Hindusthan College of Arts and Science, Coimbatore, Tamil Nadu

The electricity demands of the various countries including India are increasing at extreme rate and the power demand has been running ahead of supply. We predominantly depends on energy for almost all that in our life. Due to the tremendous amount of energy consumption the world is encounters an energy crisis because of bounded source of energy like natural gases, coals and petroleum products. Coal is the dominant source of carbon dioxide emission in the world, which causes a global warming. The search for an applicable surrogate to hydro carbons has taken many paths: nuclear, wind, solar etc. Generation of power from coal based system power plant or nuclear power plants cause pollution, which is like to be more perceptive in future due to large generation capacity on one side and more awareness of the people in this respect. So the only way of generating harmless, pollution free and cost effective energy is possible from nature only. Solar energy is the ample and easily available renewable energy source in world especially in India. However people need to use it more economically. Solar cell is also called as photovoltaic cell which converts solar energy into electrical energy. Now a days silicon based solar cells or photovoltaic cell are commercially produced because of the abundant supply of silicon raw material and its comparatively high efficiency.

Current scenario many types of photovoltaic materials are used to generate electrical energy from solar energy like Copper Indium Gallium diselenide (CIGS), Cadmium Telluride (CdTe), Titanium di-oxide(TiO_2) based di-sensitized, Cuprous Oxide (Cu_2O), Cadmium Selenite (CdSe) and Cadmium Zinc Tin Selenite (CZTS), etc. Among the all the conversion efficiency of the commercial solar cells are limited to around between 27 and 30% out of entire sun irradiation. The efficiency of the solar cells are much better improved by providing Transparent Conducting Oxide (TCO) coating over on it. Solar cells and optoelectronic devices employs TCO in their design at the front of the solar cells, these TCO layers act as the optically transparent electrode that allows all incident photons energy radiated towards the solar cell and transports the photo generated electrons to the external device terminals.

Zinc Oxide (ZnO) is a most important semiconducting material with wide band gap energy of 3.3eV and large exciton binding energy of 60meV. It is a most attractive material due to its unique properties and wide range of applications. Nowadays different synthesis techniques are designed to get ZnO structure for various device applications. Metal doped ZnO has attracted considerable attention because of its tunable optical and electrical properties. In addition, effect of various metallic dopants and synthesis procedure effect the structure, morphology, conductivity and optical properties etc.

This proposed research work covers the synthesis and characterizations of un-doped and Aluminum doped ZnO (AZO) nanostructured thin films prepared by sol-gel spin coating technique. The influence of Aluminum dopants on various properties of ZnO was systematically studied and the use of it in the field of optoelectronics and solar cells are going to be reported.

25. Physicochemical properties of ultra-small (r<2nm), digestively ripened copper oxide quantum dots: Bhusankar Talluri*, Edamana Prasad and Tiju Thomas, Department of Metallurgical and Material Engineering, and Department of Chemistry, Indian Institute of Technology Madras, Chennai-600036. E-mail: bhusankartalluri@gmail.com

Ultra-small (r<2 nm) semiconductor quantum dots (QDs) have attracted attention for applications ranging from dye sensitized solar cells to sensing due to its tunable electronic structure and band gap, and large specific surface area. The major challenges associated with synthesis of QDs include (a) achieving monodisperse population, (b) stabilization in a desired size regime, (c) controlling the surface chemistry, and (d) developing scalable and greener approaches. This is essential for the practical deployment of nanomaterials in devices. In this context, digestive ripening (DR) gains relevance - it is an effective size-focusing method in which a poly-disperse nanoparticles get converted into a nearly monodisperse population. Here we demonstrate a green solution approach for synthesis of quasi-spherical, stable (> 1 year), ultra-small, monodispersed (size ~ 2.4±0.5 nm) copper oxide QDs having radius less than 2 nm based on DR. The structural and the chemical characterization of formed CuO QDs are carried out by using X-ray diffraction (XRD), UV-Visible spectrophotometer, photoluminescence spectrometer (PL), transition electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR) and zetasizer.

It has been noticed that capping with triethanolamine (TEA) results in reduction in the average particle diameter from 9 ± 4 nm to 2.4 ± 0.5 nm and an increase of zeta potential (**ξ**) from +12±2 mV to +31±2 mV. These copper oxide QDs are monodispersed (size ~ 2.4±0.5 nm), and stable (>1 year). Electrostatic as well as steric stabilization are the responsible for the observed stability of copper oxide QDs. The hard-hard-acid-base interaction (between CuO and TEA) based (i) mass transfer and (ii) passivation seems to be primary mechanism for DR. These QDs show wide band gap of (~5.3 eV). The substantial band gap increase is currently inexplicable using Brus' equation, and is likely due to surface chemistry of these

strongly confined QDs. Photoluminescence study indicates the presence of surface defects such as oxygen vacancies and copper interstitials on copper oxide QDs. We will present detailed studies on physico-chemical properties of ultra-small copper oxide QDs. The composites of digestively ripened copper oxide QDs/graphene/rGO/polymer based hetero structures will be used for fabricating chemical sensing devices are proposed.

Keywords: copper oxide, quantum dots, digestive ripening, optical properties, hard-soft-acid-base interactions, sensing devices

References:

1. Bhusankar Talluri, Edamana Prasad, and Tiju Thomas, Ultra-small (r<2 nm), stable (>1 year) copper oxide quantum dots with wide band gap, Superlattices and Microstructures 2018, 113, 600-607.
2. Bhusankar Talluri, Edamana Prasad, and Tiju Thomas, Critical role of surfactants in the formation of digestively-ripened, ultra-small (r<2 nm) copper oxide quantum dots Superlattices and Microstructures, 2018, 116, 122-130.
3. Bhusankar Talluri and Tiju Thomas, Indications of hard-soft-acid-base interactions governing formation of ultra-small (r < 3 nm) digestively ripened copper oxide quantum dots, Chemical Physics Letters, 2017, 685, 84–88.

26. Visibly Transparent TiO_2-MoO_3 heterojunction thin film via solution process method for solar cell application: Bhuvaneshwari Ezhilmaran*, SRM Institute of Science and Technology, Kattankulathur, Kancheepuram, Chennai, Tamil Nadu

Transparent heterojunction thin film is highly attractive for a wide range of applications, such as bifacial and tandem solar cells. However, the power conversion efficiency of transparent devices still lags behind due to missing suitable transparent rear electrode or deposition process. In this work, we studied a simple and environmentally benign process for making transaparentTiO_2-MoO_3 heterojunction thin films. Transparent MoO_3 and TiO_2 precursor solutions were prepared by solution technique and spin coated on glass substrate. To study the heterojunction properties, thermally evaporated gold is used as a top metal contact and FTO as back contact to collect the charge carriers. Structural property is studied using XRD. Surface Morphological property is studied by, optical microscopy, FESEM- EDS. UV-visible spectroscopy is used to find the band gap of the materials IV characterization is carried out to study the electrical property.

27. Fabrication and characterization of biocompatible triangular pyramidal shape solid micro needle array for transdermal drug delivery: Chandbadshah S B V J*, VIT University, Vellore, Tamil Nadu

The ultimate goal of the present work is to fabricate triangular pyramidal shaped, PLGA based 9×9 micro needle array of base side 100 µm, height 350 µm and interspacing 200 µm with a sharp needle tip having diameter less than 2 µm. After fabrication micro needles array will be penetrated into artificial skin (silicone membrane) and withstand the force of insertion without breaking.

Structural analysis performed on microneedles to scrutinize mechanical strength of microneedles array. This research work launches the design of a new type of microneedles array with PLGA for Bio medical applications. A solid triangular pyramidal shaped microneedles array (9 x 9) with sharp needle tip, made up of PLGA material is considered in this article. Secure insertion of microneedles array into the human skin without breakage plays a crucial role in the design of microneedles. Microneedles arrays were modelled with three different materials (PLGA 50:50, PLGA 75:25 and PLGA 85:15) for analysis. Buckling is the common mode of failure in microneedles array. Linear buckling analysis was performed on 9 x 9 (PLGA 50:50) microneedles array. MN's arrays modelled with PLGA 75:25 and PLGA 85:15 failed due to buckling during analysis. Initially Numerical simulations were carried out by finite element software (ANSYS/AUTODYN), to simulate only single micro needle while inserted into human skin.

28. Dr. Dadamiah Shaik*, Sree Vidyanikethan Engineering College, Tirupati, Andhra Pradesh

Human activity and energy supplies mainly rely on the consumption of non-regenerative fossil fuels. With the gradual decrease of these energy sources and the increase in environmental pollution, finding alternative green and sustainable energies has become critical. Therefore, innovative and renewable energy technologies must be developed to combat global warming and climate change. Extensive research has been performed on the development of solar cells, fuel cells, lithium-ion batteries and supercapacitors.

Supercapacitors, which are also known as electrical double-layer capacitors or electrochemical capacitors, are promising energy storage devices due to their evident advantages such as high power density, friendly environment, high safety and convenient operation over a wide range of temperature, long cycle and shelf life. Although the lithium-ion battery is a dominate energy storage device for both electrical vehicles and portable electronics at the current stage, it is still not perfect in terms of performance. One of the main issues that the lithium-ion battery is usually blamed for is its safety problem. Besides, power density is playing a significant role in more and more electronic products. However, the lithium-ion battery can barely satisfy the requirements of such high power density. In situations like this, supercapacitors have

attracted growing attention owing to their high power density and safety performance. In addition, the lithium-ion battery stores energy by intercalation and deintercalation of lithium ions in two electrodes, between which lithium ions move from one electrode to the other during charging and discharging. Thus, compared to the rate of ions inserting into and extracting from electrodes, supercapacitors are able to charge and discharge much faster by absorbing and desorbing charges on the surface of electrodes. The above advantages of supercapacitors have made them promising candidates to serve as the next generation energy storage technology.

As is well known, the update of various electronic products is getting faster and faster to meet the requirements of electronic market. In this proposed circumstance, supercapacitors with high performance including energy density, power density, cycling stability, long shelf duration and short charging time, are highly demanded. Moreover, as a sustainable development strategy requested, it is also necessary to consider the environmental benignity, low cost and natural benignity when designing supercapacitor electrode materials. Materials with desirable properties is the key for realizing high-performance supercapacitors In this thesis, manganese oxide nanostructures were prepared, characterized and evaluated as supercapacitor electrodes.

Mn_3O_4 nanostructures were synthesized by using hydrothermal method at low temperatures. The morphology of Mn_3O_4 nanostructures were found to be different with different reaction temperatures and reaction times. In addition, the effect of adding H_2O_2 as an oxidizing agent was also studied. With increasing the concentration of H_2O_2, the morphology of Mn_3O_4 nanostructures changed and at a concentration of 3M, porous like morphology was achieved. The electrochemical results revealed that the electrocapacitive performance of Mn_3O_4 nanostructures depended on their microstructural properties in terms of particle size, surface area, and crystallinity. Porous Mn_3O_4 nanostructures with a high surface area exhibited the superior performance in comparison with other Mn_3O_4 nanostructures.

There is a growing interest in developing thin film supercapacitors as power sources for the ever increasing micro and nano devices such as nano electro mechanical systems, smart cards, micro sensors etc. To realize thin film supercapacitors for various applications, the development of high quality electrode film with high energy and power density, good reversibility, stable working voltage and low cost is imperative. In the present investigation, Mn_3O_4 thin films were deposited on different substrates using electron beam evaporation technique. Further, the films are annealed at various temperatures and proved that the films grown on gold coated silicon substrates annealed at 573 K exhibited superior electrochemical properties (specific capacitance = 828 F/g at 0.5 mA/cm^2 and 86% of initial capacitive retention after 5000 cycles) than as deposited films.

29. Modeling and Application of MEMS Micro Mirror in Periodic Pattern Generation: Dhakshinamoorthy.T*, Prita Nair, Department of Physics, SSN College of Engineering, Chennai, India Email: dhakshinamoorthyt@ssn.edu.in; pritanair@ssn.edu.in

This paper presents the modeling and application of MEMS micro mirror arrays in generation of periodic interference patterns using visible light, with and without defect, on the substrate for maskless lithography. The periodicity of the pattern is proportional to wavelength and inversely proportional to the incidence angle of the interfering light beams. Programmable phase modulation of the light beam reflected by each of the mirror is achieved by moving the micro mirror in the piston and tip-tilt mode of operation with the help of the actuators attached to each side of the mirror. Here 3D motion of the micro mirror is modeled using two different actuators, i) Bidirectional vertical thermal actuator-BVTA shown in Fig.1, ii) lateral shift free large vertical displacement actuator-LSF-LVD, shown in Fig.2. The choice of actuator is depends on high piston and tip-tilt displacement, and large angle of tilt. These controlling parameters are used to vary the periodicity of the pattern. Therefore LSF-LVD is chosen as an actuator for final device fabrication. The 3D motion control is achieved by combining piston and tip-tilt modes. These two modes together modulate the light beam parameters such as incidence angle (θ), azimuth angle (φ) to realize periodic pattern with and without defects.

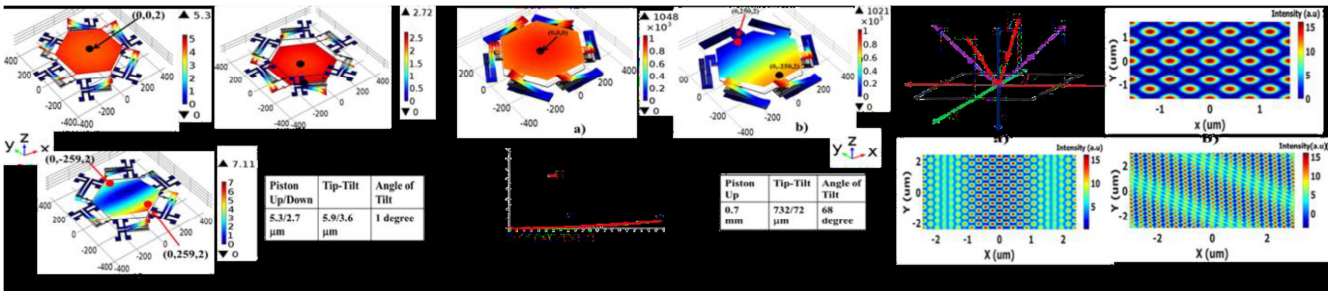


Fig.1 Fig.2 Fig.3

Fig.1. BVTA Mirror a) UP, b) Down, c) Tip-Tilt mode; **Fig.2.** LSF-LVD Mirror a) Piston, b) Tip-Tilt mode, c) Displacement Vs Input Voltage; **Fig.3.** a) 4beam interference model, b) 4 linearly polarized light beam with E1=E2= E3= E4=1; Inc.Angle θ1=θ2=θ3=θ4=30˚, Azi.angle φ1=90˚, φ2=180˚, φ3=270˚, φ4=360˚, c) Pattern with defect (Inc.Angle θ1=80˚, θ2= θ3= θ4=60˚, Azi.angle φ1=180˚, φ2=90˚, φ3=360˚,φ4=270˚), d) Pattern with defect (Inc.Angle θ1=90˚, θ2= θ3= θ4=60˚, Azi.angle φ1=180˚+45˚, φ2=90˚+45˚, φ3=360˚+45˚,φ4=270˚+45˚.)

The photonic bandgap structures (PBG) used for frequency dependent control light in optical wave guide can be 1D, 2D and 3D in nature. By interfering two unpolarized light beams, 1D pattern is realized and more than two light beams are used to generate 2D and 3D pattern. In this study, four linearly polarized beams with 400nm wavelength having equal magnitude are used and other parameters are varied to obtain 2D defect and defect free pattern as shown in Fig.3. In conclusion this system of 3 axis MEMS mirror array with overall diameter of 2mm can be used for 2D pattern generation for maskless lithography.

30. Designing low power circuits using CNTFET and exploring the possibility of fabrication of energy efficient devices like Memristor: Dr. Rasmita Sahoo*, NNRG, Hyderabad, Supervisor: Dr. S.K.Sahoo, Dr. Souvik Kundu, Department of Electronics and Communication Engineering, Birla Institute of Technology and Science, Pilani, Hyderabad Campus, Hyderabad – 500078, INDIA

Always we are looking for faster devices with high energy-efficiency and low power dissipation. This is achieved by miniaturization of transistor through scaling. Further, to overcome the short channel effects associated with the scaling of traditional MOSFETS, now-a-days researchers are focusing on search for new devices. Among many proposed devices, Carbon Nanotube Field Effect Transistor (CNTFET) is found to be one of the best alternatives. This abstract gives a brief description about the ongoing research we are involved in, the different directions in which we are planning to extend our research, different facilities available at our place and the objective of attending the seminar.

Ongoing research:

Initially, we started our research on Carbon Nanotube (CNT). We calculated some of the basic properties of different types of CNT by using tight binding model. Few characterizations are also done by using nanohub simulators. Application of CNT in CNTFET is also explored. Further, some models were developed for CNTFET to match the simulation results.

Currently, I am continuing my research in collaboration with BITS, Pilani, Hyderabad campus. We are designing and implementing different low power, energy efficient digital circuits (both binary and multivalued logic), like adders and multipliers, using CNTFET. Some of our current research publications related to this work aregiven at the end.

Different directions to extend our research:

Though we are doing theoretical and simulation based works, it is always need to have some experimental validation to strengthen our findings. In this regard I want to attend this seminar so that I can have idea about the facilities available there and their use. Once I explore the facilities, we shall streamline our research in that direction so that we can get better outputs with proper validation.

Further, we are exploring the possibility of few emerging technologies, those can be used to design energy efficient devices. Two things we are interested in are: memristor and solar cell.

Memristor: Though L. Chua was the first to report memristor in 1971, it became of immense interest for the researchers in the last decade. Recently, the application of graphene and CNT in memristor is also of keen interest for us. In BITS, Hyderabad, Dr, Souvik Kundu and their group are involved in experimental research on memristor. If possible, I would like to extend my research in that direction (in collaboration with BITS, Hyderabad) after exploring the facilities in your place.

Solar Cell: As solar cell uses sunlight which is a natural resource and is pettily available, many researchers are focusing on this field. Though solar cell is very useful, its retention efficiency is very less. So, our aim is to explore the technologies (colloidal quantum dots, thin films, perovskites etc.) to improvise the retention efficiency of solar cell.

Conclusion: Our main objective to attend this symposium is to acquire good knowledge in this field through different lectures, explore the facilities available there, to find out the suitability of doing work there, and to streamline our research direction so that we can draw good research outputs in stipulated time period.

Related publications:

1. Sahoo, Subhendu Kumar, GangishettyAkhilesh, RasmitaSahoo, and ManasiMuglikar. "High-Performance Ternary Adder Using CNTFET." IEEE Transactions on Nanotechnology 16, no. 3 (2017): 368-374.(Impact Factor - 1.702)
2. Krishna Chaitanya Sankisa, RasmitaSahoo, Subhendu Kumar Sahoo, “A CNTFET Based Quaternary Full Adder”, IEEE International Conference on Devices, Circuits and Systems- ICDCS 2018, Coimbatore, India.
3. RasmitaSahoo, R. R. Mishra, “Lattice Specific Heat of Graphene”, IEEE International Conference on Devices, Circuits and Systems- ICDCS 2018, Coimbatore, India.
4. SahooSubhendu Kumar, GangishettyAkhilesh, RasmitaSahoo, “Design of an High Performance Carry Generation Circuit for Ternary Full Adder Using CNTFET”, IEEE International Symposium on Nanoelectronic and Information Systems, Dec 2017, Bhopal, India.

Muglikar, Manasi, RasmitaSahoo, and Subhendu Kumar Sahoo. "High performance ternary adder using CNTFET." Devices, Circuits and Systems (ICDCS), 2016 3rd International Conference on. IEEE, 2016.

31. Dr. Suchismita Samantray*, College of Engineering, Bhubaneswar, Odisha

To illustrate the breadth and depth of the potential for future development of novel materials research, researchers all over the globe have chosen a material which is low cost and eco-friendly. In 21st century, materials in its broad domain underpin every technological advance and in general have now become essential ingredients for the socio-economic development and economic progress of a nation. Importance of new and exotic futuristic material has deeply ingrained in the mind of the researcher to solve the basic need of a progressive nation i.e. technological development at low cost expenses and the solution how to overcome from the future energy deficiency.

Nano science and nanotechnology are two of the hottest fields in science, business and news today which comprises the fabrication and understanding of matter at the ultimate scale at which nature designs: the molecular scale called nano scale having dimension one billionth of a meter. Nano science occurs at the intersection of traditional science and engineering, quantum mechanics and the most basic process of life itself. It refers to the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales whose properties differ significantly from those at a larger scale. Nanotechnology encompasses how we harness of our knowledge of nano science to create materials, machines and devices that will fundamentally change the way we live. It is well known that the nano materials having at least one spatial dimension in the size range of 1 to 100 nm may exhibit unique electrical, magnetic and optical properties far different from their bulk counterpart because of their low dimensionality and quantum confinement effect. These materials are expected to have a wide range of applications in various fields such as electronics, optical communications and biological systems. These applications are based on their physical properties, huge surface area and small size which offers possibilities for manipulation and room for accommodating multiple functionalities. In recent years, major progress has been achieved in molecular electronics. As the physical limits of the conventional silicon chips are being approached, researchers are seeking the next small thing in electronics through chemistry. By making devices from small groups of molecules, researchers may be able to pack computer chips with billions of transistors, more than 10 times as many as the current technology can achieve.

Nanotechnology is promising and prospective research fields nowadays, which leads to tap the potentiality of nanomaterials for using in applications to the benefit of the mankind. Nanotechnology is science, engineering and technology conducted at the nanoscale (in the order of one billionth of a meter i.e. 10-9 m). The researches on various aspects of Nanotechnology are being continued worldwide depending on respective perspective. Already people started to enjoy the discoveries and deliverables as blessings of Nanotechnology from their day to day life to the live savings medication. Remarkable applications found in electronic and computer industries from mid of 1980s. By the time, the scopes of Nanotechnology have been widened across almost all the fields of sciences, engineering and technology..The significant development resulted from the ability of manipulating and controlling atoms and molecules in nanoscale after the invention of scanning tunneling microscope (STM) and atomic force microscope (AFM). Because the particle size has spatial influence on mechanical, electrical, optical, catalytic, magnetic properties of the materials in solid state in particular. Nanotechnology emerged as a prospective field of study from three remarkable phenomenon; such as (i) quantum hall effect across two dimensional (2D) electron gas, (ii) the invention of scanning tunneling microscope (STM) and (iii) the discovery of fullerene (C60) as a new form of carbon, discovered in 1985 by Harry Kroto, Richard Smalley and Robert Curl jointly[1]. Another remarkable invention is the atomic force microscopy (AFM) having capability to measure and assemble the atoms individually, gave impetus to the birth of Nanotechnology. Finally in 1990, the invention of carbon nanotube (CNT) established the launching pad of today's Nanotechnology.

Using nanotechnology, materials can effectively be made stronger, lighter, more durable, more reactive, more sieve-like, or better electrical conductors, among many other traits. Many everyday commercial products are currently on the market and in daily use that rely on nanoscale materials and processes. It is helping to improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, and among many others. Nanotechnology offers the promise of developing multifunctional materials that will contribute to building and maintaining lighter, safer, smarter, and more efficient vehicles, aircraft, spacecraft, and ships. Nanoscale sensors and devices may provide cost-effective continuous monitoring of the structural integrity and performance of bridges, tunnels, rails, parking structures, and pavements over time. Research in the use of nanotechnology for regenerative medicine spans several application areas, including bone and neural tissue engineering. For instance, novel materials can be engineered to mimic the crystal mineral structure of human bone or used as a restorative resin for dental applications. Researchers are also studying ways to use graphene nanoribbons to help repair spinal cord injuries; preliminary research shows that neurons grow well on the conductive graphene surface. Nanotechnology has also greatly contributed to major advances in computing and electronics, leading to faster, smaller, and more portable systems that can manage and store larger and larger amounts of information.

Recent developments in composite materials having nanometer size particles have created a new research field in electrical insulation, being referred to as nanodielectrics . It is the study of dielectric phenomena and materials on the nanometric scale and the fabrication of structures, devices and systems that have novel dielectric properties because of

their nanometric structure. Insulation integrity is of great importance for all electrical power applications, including energy conversion, power delivery, energy storage, and power consumption. Nanodielectrics can enhance the reliability of current systems and more importantly, can improve their efficiency by enabling innovative design and the utilization of renewable energy resources.

32. Development and Characterization of High Performance Light weight Magnesium Alloy Based Composites: Elumalai P.C*, Ganesh R, Assistant Professor, Department of Mechanical Engineering, Velammal Engineering College, Chennai-66.

The present scenario in the field of materials research is directed towards lightweight materials having unique properties such as high specific strength, high stiffness etc. Magnesium is the lightest metal - 35% lighter than Aluminium, is useful for automotive and aerospace applications. Magnesium matrix composites have been realized in recent times for its potential of wide spread applications. The remarkable properties of magnesium matrix composites such as high specific strength, high stiffness, low thermal coefficient of expansion, high castability and machinability, better wear resistance, effective damping capacity and biodegradable nature etc., Addition of suitable ceramic reinforcement with magnesium alloy improves its mechanical behaviour significantly to a larger extent in order to meet the desired tailor-made properties of structural and biomedical applications. The availability of wide variety of reinforcement materials and development of new processing methods provides the opportunity to develop new materials suitable for required application.
Keywords: magnesium matrix composites, fabrication, characterization, biomedical, structural, review.

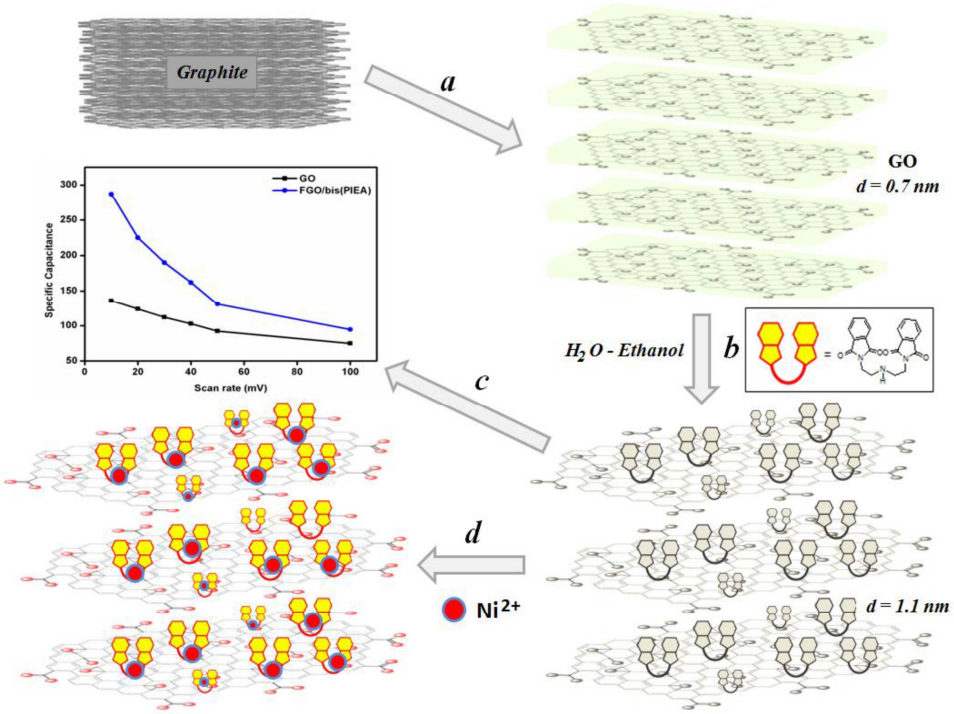
33. Oxide Barriers for Future Memory Devices: Harish Kittur*, VIT University, Vellore, Tamil Nadu

The MOSFET, a hetero-structure of metal, oxide and semiconductor has heralded and sustained the present advances in electronic computing. Crucial to the operation of the MOSFET is the quality of the thin, nearly 1 nm or even lower, oxide layer of SiO2. High-k dielectrics e.g. HfO2 layers can be much thicker, nearly 4-6 nm. The quality of the oxide layer is determined by the epitaxy of the layer, the uniformity of the layer across the chip, impurities present in the layer and, the interface of the oxide layer with the adjoining layers. A poor quality oxide layers leads to: i) greater leakage currents (static leakage current through tunneling), ii) threshold voltage shifts of the MOSFETs due to the oxide charges, iii) Reduced drive strength of the MOSFET due to the lower mobility of the channel carriers and also the reduced capacitance of the gate and, iv) on-chip variations due to thickness changes . The quality of the oxide barrier is not only important for the transistors used as components of gates but also for the transistors used as memory storage devices like the floating gate transistors of FLASH. The quest for the ideal/universal memory device has motivated researchers and technologists to explore and propose various novel memory devices. Some of the widely researched novel memory devices are: Ferroelectric RAM(FeRAM), Magnetic RAM (MRAM), Phase Change Memory (PCM) and, more recently the Resistive RAM (RRAM). A variant of the Magnetic Hard Disk Memory is the Race Track Memory and it is not the subject of interest here. Again crucial to the successful operation of the FeRAM, MRAM and, the RRAM is the quality of the oxide layer. The quality of the oxide layer is not only a function of the materials employed but also of the process employed to make the oxide layer. The objective of this proposal is to explore materials and processes that would lead to high quality oxides for electronic devices. In particular we would like to investigate and develop high quality oxides for RRAM applications. A lot of conventional oxidation techniques are already available for the growth of the oxide layer, some examples being: thermal oxidation, plasma oxidation, deposition in the presence of oxidizing gas and many others. However we would like to explore the oxidation in the presence of Ultraviolet (UV) light. It is well known that UV interacts with molecular oxygen (O2) to produce atomic oxygen (O) and ozone (O3). The oxidizing power of both O and O3 is superior to that of molecular oxygen. Besides the direct irradiation of the surface to be oxidized with the UV light, can permit accelerated oxidation of selective regions of the chip surface. Such accelerated oxidation of selective parts of the chip will lead to new processes, enabling the efficient fabrication of existing and novel devices.
The targeted outcomes of the project are:
i) High quality oxides for RRAM devices
ii) New processes for the growth of high quality oxides for electronic devices

34. A Facile Synthesis of Bis-(ptththalimidoethyl)-amine Functionalized Graphene Oxide and Its Dual Performance as a Supercapacitor Electrode and Fluorescence Sensor: Ramesh Pugulanthi, Srinivasan, A., Bhalerao, G. M., Jebasingh, B*, Department of Chemistry, Karunya University, Coimbatore-641 114, INDIA, jebasinghb@karunya.edu

In the work, we report a facile synthesis of Bis-(ptththalimidoethyl)-amine functionalized graphene oxide (GO-bis(PIEA)) using a masked diethylenetriamine derivative as an intercalating agent on the surface of GO for the supercapacitor applications. The prepared material was fully characterized by XRD, XPS, Raman and microscopic techniques and its

fluorescence behaviour due to the presence of phthalimide conjugate was also studied. The GO-bis(PIEA) material shows the sheets like nanostructure with *d*-spacing of 1.1 nm (2θ = 8.7 deg.) between the sheets due to the covalent intercalation and thereby exhibits better specific capacitance of 287 F g-1 at a specific current density of 1 A g-1 in 6M KOH. A very low capacitance degradation of 5.5% was noted upto 1000 cycles. The GO-bis(PIEA) material was also working well as a selective fluorescent chemosensor for Ni2+ ion in aqueous solution at neutral pH and proves no cross-reaction with any of the potential interfering metal ions. The dual enhancement of dissimilar properties such as capacitance and fluorescence emphasized the continued significance of covalent functionalization towards tuning the properties of graphene-based materials.



35. Growth and Structural Characterization of Ta: In_2O_3 Thin Films: K. GangaReddy*, Y. Veeraswamy, Mallikarjun, D Sunil Gavaskar, M. V. Ramana Reddy, Dept. of Physics, Osmania University, Hyderabad, Telangana-500007, India, Email: kgratphysics@gmail.com

High purity Tantalum oxide and indium oxide powders are taken as starting materials to prepare Tantalum doped Indium oxide powder by solid state reaction method to prepare robust targets of $(In_{1-x}Ta_x)_2O_3$ (x=0.06) for Pulsed Laser Deposition (PLD) to grow Ta:In_2O_3 Thin films, prepared pellet was sintered at 1000^oC for 12hours. The films are deposited on ultrasonically cleaned (100) oriented Silica substrates are maintained at a substrate temperature of 400^oC. The vacuum chamber evacuated by a turbo molecular pump to a base vacuum better than 10^{-6} Torr and oxygen partial pressure was maintained at 0.3 mTorr. The deposited film structural characterization was done by GIXRD, EDS and stylus profile meter. UV-Vis spectroscopy and Photoluminescence spectroscopy studies are performed for optical properties of the deposited films. GIXRD suggest polycrystalline nature with the preferred orientation along (222) direction. CIE plots confirm that deposited films are applicable for blue LED.
Keywords: Metal oxide thin films, Pulsed laser deposition, Photoluminescence etc.

36. Performance Enhancement of Tunnel FETs Using Source Pocket: Manas Ranjan Tripathy*, Indian Institute of Technology (BHU) Varanasi, Varanasi, Uttar Pradesh

The down-scaling of conventional MOSFETs has led to the generation of more leakage current for which static power dissipation is becoming more prominent. To improve the energy efficiency of electronic devices, small sub-threshold swing based devices are suitable candidate to replace or complement MOSFETs. The tunnel field effect transistors (TFETs), also called “Green Transistors” had drawn significant attention in recent times due to its ability to provide steeper sub-threshold

swing and extremely low power dissipation characteristics. TFET works on the principle of Band to band tunneling (BTBT). The tunneling probability according to WKB approximation is given by

$$T_{WKB} \approx \exp\left[-\frac{4\lambda\sqrt{2\mathrm{m}} * \sqrt{E_g^3}}{3q\hbar(\mathrm{E_g} + \Delta\Phi)}\right]$$

It indicates that tunneling probability depends upon band gap (E_g), effective carrier mass(m*) *i.e.,* the properties of the material system and tunneling length (λ). The tunneling length strongly depends on device geometry, dimensions, gate-capacitance and doping profiles. Thus, by making use of material with lower bandgap at the Source, tunneling probability can be increased significantly. Moreover, the reliability of the device can be improved by introducing a highly doped pocket at the source-channel junction.

However, TFETs possess low drive current due to high tunneling barrier created at the source/channel junction, which can be improved by applying various engineering techniques such as hetero-junction (*i.e.,* use of low band gap material such as Ge, InAs), work function engineering (*i.e.,* dual-metal, tri-metal), channel engineering (*i.e.,* strained silicon) source/drain engineering (*i.e.,* low band gap materials as source) and gate dielectric engineering (*i.e.,* high-*k*, ferroelectric materials) have been explored to improve the drive current of TFET devices. Hetero-junction with source pocket technique is one of the techniques which can be used to improve the drain current as well as sub-threshold swing. The TFET with source pocket has the same structure as that of conventional p-i-n TFET except for the formation of n^+ pocket between the source and the channel. Using n^+ pocket, we can enhance on-state current and reliability issue compared to that of conventional p-i-n TFET as well as we can have a steep sub-threshold slope and reduced operating voltage. Our proposed structure consisting of hetero-junction double gate (front gate as well as back gate), where Ge is used as source material, Si is used in the pocket, drain as well as in channel. Our proposed device length is 90 nm out of which source length is 20 nm with doping concentration 10^{19} per cm^3, pocket length is 4 nm with doping concentration 10^{19} per cm^3, channel length is 50 nm with doping concentration 10^{16} per cm^3 and drain length is 20 nm with doping concentration 10^{19} per cm^3 , respectively. We have taken gate oxide thickness and channel thickness as 2nm and 12nm. The performance enhancement of HJ TFET can be achieved with source pocket in the terms of ON-state current (10^5 A/μm), OFF-state current (10^{-16} A/μm) and subthreshold swing (15 mV/dec).

Our work investigates the influence of source pocket on the electrical characteristics of hetero-junction double-gate tunnel field effect transistors (HJ DGTFETs). It has been observed that the increment of drain current and lower sub-threshold swing can be achieved by using n+ source pocket in the proposed HJ-DGTFET devices. We have done simulation using 2-D device simulator ATLAS^{TM} SILVACO and the results show that the average SS improved and I_{ON}/I_{OFF} increases for optimum value of pocket length of the proposed device.

References:

1) S. Kumar et al., *IEEE Trans. Electron Devices*, vol. 60, pp. 3291-3299, Aug. 2016.
2) D. B. Abdi et al., *IEEE Electron Device letters*, vol. 35, pp. 1170-1172, Dec. 2014.
3) K. Boucart and A. M. Ionescu, "*IEEE Trans. Electron Devices*, vol. 54, no. 7, pp. 1725– 1733, Jul. 2007.
4) S. Chander and S. Baishya, *IEEE Electron Device Letters*, vol. 36, pp. 714-716, July 2015.
5) S. Kumar et. al, *IEEE Trans. Electron Devices*, vol. 64, pp. 960-968, Mar. 2017.
6) M. Kumar and S. Jit, IEEE Trans. Nanotechnol., vol. 14, no. 4, pp. 597–599, Jul. 2015.
7) M. H. Lee et al., *AIP Advances* , vol.4, pp. 107117-6, 2014.
8) M. Kumar and S. Jit, *IEEE Trans. Nanotechnol*., vol. 14, no. 4, pp. 00–602, Jul. 2015.
9) K. Boucart, and A. M. Ionescu, "Double-gate tunnel FET with high-κ gate dielectric," IEEE Trans. on Electron Devices, vol. 54, no. 7, pp. 1725-1733, Jul. 2007.
10) ATLAS: Silvaco International (2008).

37. Design and Fabrication of Piezoelectric Energy Harvester for Medical Applications using Intelligent Optimization Techniques: Mangaiyarkarasi Padmanaaban*, Anna University, Chennai, Tamil Nadu

Large-scale ambient energy is widely available in the environment and large-scale technologies are being developed efficiently to capture it. But in small-scale, since technologies are not developed, energies that are generated from heat, light, sound, vibration etc., are not efficiently captured. If small-scale wasted energy in the environment are captured, it can be more useful for low-power electronic applications. Vibration energy is the most wasted energy in the environment when compared to heat, light, sound etc., Energy harvesting is used to convert vibration energy into usable electrical energy by using energy harvesting devices. Energy harvesting techniques are of two types. They are: Macro Scale Energy harvesting (solar, wind, thermal etc.) and Micro Scale energy harvesting (Piezoelectric, Electromagnetic, Electrostatic etc.). In Macro scale energy harvesting, large scale technologies are developed extensively to capture the power, when compared to Micro scale energy harvesting. In this work, vibration energy harvesters are designed by using MEMS [Micro Electro Mechanical Systems] Technology. To convert the energy from ambient vibrations into electricity, various power harvesting techniques, Electrostatic, Electromagnetic, Piezoelectric etc., can be developed. Due to the drawbacks in the electrostatic and

electromagnetic energy harvesters, Piezoelectric energy harvesters are chosen. In the proposed research work, MEMS based Piezoelectric energy harvester [unimorph and bimorph] is designed. They are mainly designed to enhance the performance of the energy harvester in medical applications. Lead Zirconate Titanate (PZT-5A) is the material used in the proposed work. Piezoelectric energy harvester, are used in medical applications like Pacemaker, Ear Canal bending sensor etc.

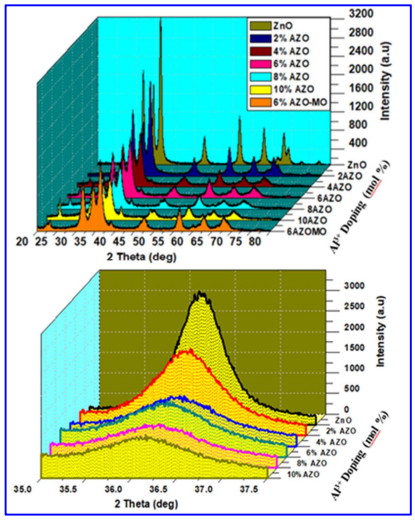
Pacemaker - In Pacemaker, cantilever design of piezoelectric energy harvester, harvests energy from blood pressure variation in cardiac cycle. This variation produces electric potential on the surfaces of piezoelectric element which can be used for battery charging of pacemaker. Material used in the proposed work is PZT-5A. The objective of the proposed work is to design the harvester in such a way that the natural frequency of the system is close to heart beat frequency i.e. 1-2 Hz and investigate the output voltage and power which are sufficient for powering a typical pacemaker. The output voltage should be sufficient enough to charge the pacemaker battery from time to time.

Ear Canal Bending Sensor - The ear-canal shape varies for every individual and alternately changes when the jaw moves due to munching, chomping or talking. The ear-canal deformation can be contemplated by the geometrical analysis of a distorted earpiece custom-fitted inside the ear-canal, but the distortion of the earpiece is complex in nature and complicated to analyze. An ear-canal bending sensor consisting of a thin piezoelectric strip [PZT-5A] is attached to a custom-fitted earpiece. An analytical approach based on computing the geometrical parameters of distorted and undistorted earpieces is developed to: 1) estimate the average bending moment 2) calculate the sensitivity of the piezoelectric ear-canal bending sensor. By this way we can evaluate the energy capacity of ear-canal deformation for in-ear energy harvesting purposes. Optimization Techniques such as Grey-Wolf optimization, Bat Algorithm, Fruit-fly algorithm, Modified monkey search algorithm etc., are mainly used to optimize the parameters of the piezoelectric energy harvester, thereby enhancing the performance of the energy harvester.

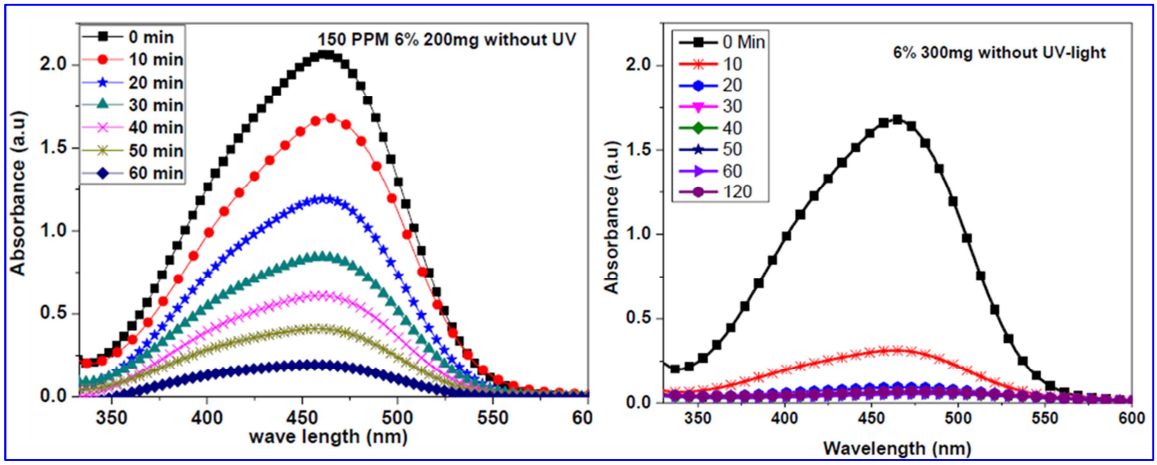
Keywords - Piezoelectric energy harvesters, PZT-5A, Medical Applications, Optimization techniques.

38. $Zn_{1-x}Al_xO$ nanoparticles: An excellent adsorbent for methyl orange dye derived by simple solution combustion synthesis: Manjunatha. C*, Koushik. H. M , Abhishek. B, Mrutunjaya. Jena, Nagaraju. G, Department of Chemistry, Department of Mechanical Engineering, R.V. College of Engineering, Bengaluru-560059, India

In this work, to explore the adsorbent property of ZnO, we have prepared Al^{3+} doped ZnO nanoparticles (AZO NPs) via solution combustion synthesis using glucose as a fuel. The prepared AZO NPs were systematically characterized using powder X-ray diffraction (PXRD), Scanning Electron Microscope (SEM), Fourier Transform Infra-Red (FT-IR) and UV-Vis spectroscopy. The PXRD peaks at 2θ = 31.67°, 34.31°, 36.14°, 47.40°, 56.52°, 62.73°, 66.28°, 67.91°, 69.03°, and 72.48° were assigned to (100), (002), (101), (102), (110), (103), (200), (112), (201), and (004) of ZnO NPs, indicating that the samples were polycrystalline wurtzite structure (Zincite, JCPDS 5-0664). No characteristic peaks of any impurities were detected, suggesting that high-quality AZO NPs were synthesized. The crystallinity of the AZO NPs is significantly changed with increase in doping percentage. The PXRD peak (101) at 36.14^0 is found to be very intense for un-doped ZnO, however with increase in Al^{3+} doping the peak intensity is considerably decreased. It is also observed that the highly intense peak (36.14^0) is shifted uniformly towards lower angle (35.5^0) with increase in doping percentage. The surface morphology was studied using SEM exhibits unique morphology with different mol% of Al^{3+}. The AZO NPs was used for adsorption of Methyl Orange (MO) in water. The adsorption efficiency of doped ZnO is extremely high as compared to undoped ZnO. We have also compared the adsorption efficiency among doped ZnO NPs. It is found that 6% AZO NPs exhibit highest adsorption efficiency as compared to 2, 4, 8 and 10 mol% doped AZO NPs. It is found that 200mg of 6% AZO NPs adsorb 50ppm MO in 10 min, 100ppm MO in 20 min and 150ppm MO in 30 min in the presence of visible light.



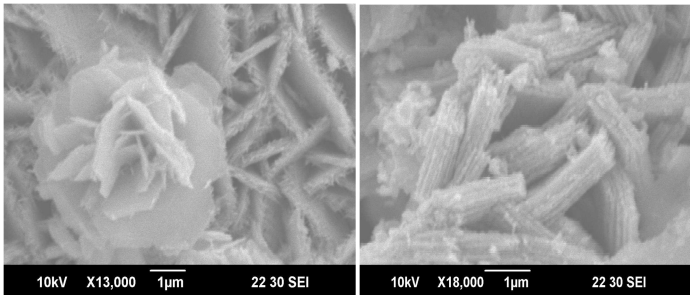
Further, to confirm whether the MO dye is degrading or adsorbing on AZO NPs, we have studied the adsorption studies in the presence of UV and Visible light. The UV-Vis spectral results recorded for the MO dye in both experiments (UV and Visible light) showed almost similar results. It confirms that the decolourisation of MO dye is due to adsorption and not due to photo catalytic degradation. This is further confirmed by recording FT-IR spectra for MO dye, pure AZO before adsorption, and AZO-MO after adsorption studies. Two bands located at ~1606 and 1519 cm^{-1} are assigned to υCC



vibrations in the aromatic rings; the bands at 1444 and 1415 cm^{-1} corresponds to υCH_3 vibrations and a band located at 1366 cm−1 is assigned to the azo group υN=N vibration. Bands assigned to sulphate groups from sulfonate species were also detected in the range between 1250 and 1000 cm^{-1}. These studies showed the almost 100% MO removal in just 10 min is possible by using 300 mg of 6% Al^{3+} doped ZnO.
Keyword: Nanoparticles, Al^{3+} doped zinc oxide, Photocatalyst, Methyl orange

39. Cotton template replicated $Ni_{1-x}Mg_{01-x}Co_2O_4$@C (x=0.5) nanofibers composites as an electrode material for high performance supercapacitor: Meenu Sharma* and Anurag Gaur, Department of Physics, National Institute of Technology, Kurukshetra-136119 , Haryana, India, Email: 15.meenusharma@gmail.com, anuragdph@gmail.com

The sustainable and reproducible energy systems are indeed to solve global energy problems. Among these system supercapacitors and Lithium-Ion Batteries, energy storage devices have received increased attention for their great potential because of the rapid expansion as well as environmentally friendly energy conversion with efficient usage in hybrid electric vehicles and portable electronic devices [1]. Supercapacitors are more efficient for electrochemical energy storage devices due to their outstanding electrochemical properties including fast charging, good cyclic stability, moderate energy and high power density. Due to these enormous advantages, supercapacitors are gaining interest from various researchers for their applications in hybrid electric vehicles, portable electronic and memory backup devices etc. In recent years, for supercapacitors application, different metal oxides have been successfully used as electrode materials, because of their high specific capacitance, low cost, controllable structure, and unique morphology [2].
In this context, electrochemical analysis of Mg-doped $Ni_{1-x}Mg_xCo_2O_4$@C (X=0.5) composites synthesized via hydrothermal method using with and without a cotton template, respectively is done systematically. Notably; the morphology altered from nanoflowers to nanofibers is achieved with the incorporation of cotton templates and mg ion. NMCo@C(x=0.5) nanofibers exhibit almost double BET surface area of 51.7 m^2g^{-1} with porous of 2-12 nm range.



SEM image of Nanoflowers SEM image of Nanofibers

Ultimately, When the electrochemical analysis was done potentiostatically in a three-electrode setup, the fabricated electrode of NMCo@C(x=0.5) nanofiber structured material demonstrates specific capacitance of 1340 Fg^{-1} at current density 1 Ag^{-1} and admirable cycling stability 97% of the initial capacitance upto 2000 cycles at a high current density of 15Ag^{-1}. Remarkably it also demonstrated energy density of 59.5 $WhKg^{-1}$ at a current density of 1Ag^{-1}. Energy density increases upto two times compared to nanoflowers structured material which can be attributed to more porous nature of nanofibers and greatly enhanced the surface area. The significant electrochemical performance of will makes this composite will definitely make attractive electrode material for high-performance supercapacitors.

References:

[1] Zhu, Yirong, et al. "Mesoporous NiCo2S4 nanoparticles as high performance electrode materials for supercapacitors." *Journal of Power Sources* 273 (2015): 584-590 [2] Dubal, Deepak P., et al. "Nickel cobaltite as an emerging material for supercapacitors: an overview." *Nano Energy* 11 (2015): 377-399.

40. Thermoelectric studies of Magnetic Tunnel Junctions: Midhun shah*, P.P.Pradyumnan, Department of Physics, Farook College, Calicut, Department of Physics; University of Calicut; Malappuram, Kerala.
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Thermoelectric materials can directly and reversibly convert heat energy into electrical energy. The Thermoelectric conversion mechanisms are becoming increasingly attractive because of the lack of moving parts, low maintenance and high reliability. The worldwide research in the topic of thermoelectric (TE) materials usually emerge with creative solutions and applications like tailpipes of carbon neutral vehicles, power sources of satellites and space probes, bio thermal batteries, localised cooling for electronic components etc [1]

The efficiency of the thermoelectric energy conversion is expressed by dimensionless figure of merit, ZT= σS^2 T/k

Where, σ is the electrical conductivity, S the Seebeck coefficient, T the temperature and k the thermal conductivity. As the equation indicates maximization the thermoelectric figure of merit (ZT) require, high Seebeck coefficient, high electrical conductivity, and low thermal conductivity [2]. A good thermoelectric material should have glass like thermal conductivity, metal like electrical conductivity and semiconductor like Seebeck coefficient. A conventional way to increase the ZT value is to alter an already promising compound by introducing point defects through solid solution synthesis methods. Another way to achieve high ZT is the “phonon glass electron crystal” (PGEC) approach. Nanoparticles in the alloy approach, Modulation doping, doping optimization are the usual methods used to enhance ZT. Different materials like multichalcogenides, Skutterudites, Half-Heusler Compounds, Clathrates, quasi crystals are explored for the purpose.

Here we propose the thermoelectric studies on Magnetic Tunnel Junctions (MTJ) for application in data storage devices and TE power generation. Spin caloritronics is a research direction that provides modified strategies for thermoelectric power generation and refrigeration by employing an additional spin degree of freedom. Magnnetic nanostructures exhibit spin dependant Seebeck and Peltier effects. Different spin channels behave differently and the behaviour can be regulated by changing the magnetization direction [3] [4]. Magnetic tunnel junction (MTJ) consists of two ferromagnetic layers separated by a thin insulator (Non magnetic material). The insulating layer should be very thin (1-3 nm) so that the electrons can tunnel from one ferromagnetic layer into the other. Magneto thermoelectric effects in magnetic tunnel junctions (MTJs) were measured recently, driven by their emerging applications in data storage. High values of magneto thermoelectric effects have been reported by Weiwei Lin et al., 2011. Walter et al reported the measurements of Seebeck effect in MgO based MTJs. Their experiments show that the magnitude and sign of the magneto-Seebeck ratio can be changed by directing a LASER source to produce heating. Temperature difference less than 1K between the junctions can generate thermoelectricity. It is reported that when a magnetic configuration changes, the Seebeck coefficient also changes. In particular, the Seebeck coefficient varies during the transition from a parallel to an anti parallel magnetic configuration. This can be calculated using

$$S_{\mathrm{MS}} = \frac{S_{\mathrm{P}} - S_{\mathrm{AP}}}{\min(|S_{\mathrm{P}}|, |S_{\mathrm{AP}}|)}.$$

Here SP is the Seebeck coefficient for parallel magnetization and SAP for antiparallel Magnetization. The size and sign of the effect can be controlled by the composition of the electrodes, atomic layers adjacent to the barrier and the temperature. The magnitude and sign of magneto seebeck effect can also be controlled by varying the thickness of tunnelling film and by introducing oxygen vacancies in the structure. [5] - [7].

Theoretical aspects of FeCo/MgO/FeCo MTJ's were studied by Shi-Zhuo Wang and Ke Xia. They reported thermoelectric behaviour of FeCo/MgO interfaces and the significant deviation from the Wiedemann-Franz law at room temperature [8][9]

The commonly used material for magneto seebeck effect is FeCo/MgO/FeCo structures. The proposed work suggest the use of CoFe,MnBi, MnSb, NiFe, NiOFe2O3 as outer layers which are good thermoelectric as well as ferromagnetic materials, and Al2O3,Ti2O3,TiO2 as the tunnelling barrier. The works proposes the introduction of anti ferromagnetic pinning and double pinning layers to control the switching times response to external magnetic field. MnO, MnS, MnTe, NiO may be used for this purpose. Using these materials, we may improve the current status of magneto seebeck effect and its exploitation in magneto electric and magneto optic devices and materials.

References:

1. Anju Paulson, Muhammed Sabeer N A, Pradyumnan P P, Enhanced thermoelectric property of oxygen deficient nickel doped SnO2 for high temperature application, Materials Research Express,2018 (In press)
2. P. Maneesha, Anju Paulson, N.A. Muhammed Sabeer, P.P. Pradyumnan,Thermo electric measurement of nanocrystalline cobalt doped copper sulfide for energy generation, Materials Letters,2018 (In press)
3. S. T. B. Goennenwein and G. E.W. Bauer, Spin caloritronics: Electron spins blow hot and cold,Nat. Nanotechnol. 7,145 (2012)
4. G. E. W. Bauer, E. Saitoh, and B. J. van Wees, Spin caloritronics,Nat. Mater. 11,391 (2012)
5. Walter, M. *et al.* Seebeck effect in magnetic tunnel junctions.*Nature Mater.* 10, 742–746 (2011).
6. Lin, W. *et al.* Giant thermoelectric effect in Al2O3 magnetic tunnel junctions. *Nature Commun.* 3, 744 (2012).
7. Keyu Ning *et al.* Magneto-Seebeck effect in magnetic tunnel junctions with perpendicular anisotropy, AIP Advances 7, 015035 (2017)
8. Shi-Zhuo Wang and Ke Xia, Thermoelectricity and disorder of FeCo/MgO/FeCo magnetic tunnel junctions, PHYSICAL REVIEW B 90, 224406 (2014)
9. P. P. Pradyumnan, Superparamagnetism in FeCo nanoparticles, NANOSYSTEMS: PHYSICS, CHEMISTRY, MATHEMATICS, 2016, 7 (4), P. 675–677

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Now a days Tropical diseases are wide spread in the Tropical and Subtropical regions. These tropical diseases are wide spread in hot and cold climates leads to pathogenic agents. Which may include malaria, dengue, Tetanus, Hepatitis, yellow fever, cholera and many others. The identification of those tropical diseases contains serologic testing of infective markers like macromolecule, antigen, and protein X-rays, physical examination still as activity microorganism and fungous culture techniques. These strategies needs sample of body fluid like blood, mucous secretion (or) excretory product samples. But the identification of tropical diseases needs many challenges which incorporates prolonged work time for assessment of specimens, Controlled surroundings, extremely trained personnel and large blood (or) liquid body substance samples and conjointly this can be the foremost valuable. Not just for these tropical diseases, to look at a pathologic organ or bad of a joint during a physical structure, go across the skin and open up the body then exclusively they might verify the character of drawback and decides the course of action. However which can or might not happen throughout surgical procedures In Order to provide diagnostic technique more easily recent researches and studies from past few years proposed numerous biomedical engineering approaches with non-invasive biomedical sensors. Some of they are Bioelectric Impedance Analysis, Die electro Pharoses, Image processing, Micro Array chip, Micro Fluidics and Lab on a chip, Spectroscopy Technique etc. can depict the long run perspective of MEMS/NEMS biomedical sensing technologies and corresponding exploitation opportunities for the development of cantilever based Bio-MEMS with chemical sensing. As a result of the integration of micro/nano devices with the purposeful sensitive material introduces new features and better performance to the chemical sensing systems, like higher sensitivity, higher specificity, higher throughput, economical system design.

42. Monisha P*, Sri Sarada College for Women, Salem, Tamil Nadu

Nanomaterials exhibit superior properties in comparison to their bulk counterpart as in nanocrystalline material. The physical properties are primarily controlled by the grain boundaries than by the grains. Magnetic nanomaterials draw increasing attention in several technological fields including magnetic fluids, permanent magnets, microwave devices, magnetic drug delivery, high-density information storage devices, magnetic cell separation, switching devices, biomedical applications, magnetically controlled transport of anti-cancer drugs, recording tapes, energetic components of ferro fluids, magnetic resonance imaging, contrast enhancement, read–write heads, etc.,

Currently, the global community suffers from serious environmental problems arising from an excessive combustion of fossil fuels. Consequently, many researchers have paid great attention to manipulate the clean and sustainable energy sources as well as efficient energy conversion and storage technologies. Batteries and supercapacitors are the typical devices used for the storage of electrical energy. Both of these store electricity through electrochemical processes. Compared to the batteries, the supercapacitors are characterized by higher power density, rapid charge/discharge and long-life service. Despite the advantages of high power density and high life cycle of supercapacitors, their intrinsically low energy density has limited them from widespread commercial applications in comparison to batteries. Hence increasing their energy density requires an extensive research and development, including the merge of batteries and supercapacitors.

Based on the active materials, supercapacitors (SCs) are classified into two main types: electrochemical double layer capacitors (DCs) and electrochemical pseudocapacitors (PCs). The active material in the DCs is composed of carbon-based materials, such as activated carbon, graphite and graphene. Energy is stored physically within a DC via charge accumulation across the electrode/electrolyte interface. As for PCs, the active material is primarily composed of a transition metal (TM) oxide, a TM nitride or a conducting polymer. Energy is stored electrochemically within a PC via the reversible interfacial redox reactions in TMs or via ion intercalation throughout the electrode in conducting polymers. Due to the intrinsic low specific capacitance (C_{sp}) and low energy density stored in the current SCs, it is vital to explore new materials that simultaneously exhibit high C_{sp} as well as high conductivity.

Transition metal oxides possess several oxidation states that are favorable for rapid redox reactions, leading to efficient and high-quality energy storage and conversion systems. Therefore, TMs are engrossed as the electrode materials for supercapacitor applications because of their outstanding electrochemical performance. In addition, TM oxides can provide a higher theoretical C_{sp} than that of the conventional carbon-based materials and a better electrochemical stability than that of the polymeric materials. Among them, RuO_2 has been widely investigated as a promising candidate because of its better conductivity and high C_{sp}. However, it is limited by its high cost, rarity and toxicity. Alternative inorganic electrode materials such as MnO_2, Co_3O_4, NiO, V_2O_5/VO_4, WO_3 and Fe_2O_3 have been intensively investigated in SC applications owing to their wide availability, mechanical strength, safety and eco-friendliness. However, the single metal oxides generally suffer from low conductive properties and unfavorable stability, which constrain the performance of energy storage and conversion systems. This is why the recent rise of binary metal oxides which were paid much attention in energy storage and conversion applications by virtue of their better conductivity and electrochemical performance.

The ferrospinel of general formula $M^{2+}[Fe^{3+}]\ O_4$ possessing ferric ion in square bracket occupies the octahedral position and the metal ion outside the bracket occupies the tetrahedral site. M^{2+} represents the divalent ion such as Mn^{2+}, Zn^{2+}, Co^{2+}, Cu^{2+}, Ni^{2+} etc. The breakthrough has been achieved when it is discovered that ferrites exhibit high permeability and the ability to exhibit several redox states than those of the monometallic oxide which make them suitable electrode materials for supercapacitors.

A promising approach to enhance the performance is designing novel ferrite-based hybrids. Ferrite spinels may also consist of a mixture of two divalent metal ions, in which the ratio of these divalent ions may vary and are referred to as mixed ferrites. The cation distribution of mixed ferrite significantly affects the surface properties of ferrospinels making them catalytically active. Because of their small size and large number of cations for coordination sites, nanocrystallites are capable of enhancing the rate of chemical reactions and are increasingly gaining popularity as reactive nanocrystallites.

43. Investigation of Structural, Morphological, Optical and Electrical Properties of Pure and Transition Metals Doped ZnO Nanoparticles for Organic Solar Cell Applications: Murugesan Silambarasan* and Shanmugam Saravanan, Centre for Photonics and Nanotechnology, Sona College of Technology, Salem - 636 005, Tamil Nadu, India *Email: silambu.physicist@gmail.com

Zinc oxide (ZnO) is a very promising II-VI compound semiconducting material employed in a wide range of fields, such as in photonics, optoelectronics, materials science and engineering. Among the synthesis methods of nanoparticles, solution combustion method is an ideal method for preparing the metal oxide nanoparticles. It provides a simple, cost effective and easy route to obtain large quantities of ZnO nanoparticles. Hence, we have synthesized the ZnO nanoparticles by solution combustion method and we have incorporated transition metals such as Mn, Fe, Ni and Ag as doping agents along with ZnO nanoparticles by the same method.

Powder XRD pattern of all the prepared ZnO nanoparticles depicts the hexagonal wurtzite structure with the average crystallite size of around 30–60 nm. In the transition metals doped ZnO samples, XRD pattern of Mn-doped ZnO nanoparticles exhibit the hexagonal wurtzite structure and there are no extra peaks due to Mn metal, other oxides or any zinc-manganese phase. The Fe, Ag and Ni-doped ZnO nanoparticles indicated that the prepared samples are in hexagonal wurtzite structure with secondary phase of FCC structure of Fe3O4, Ag and rock salt structure of NiO, respectively. Raman scattering of Mn-doped ZnO nanoparticles have bonds of the wurtzite ZnO along with the characteristic peak of Hausmannite complex oxide of manganese (Mn2+Mn23+O4). In Fe/Ni-doped ZnO nanoparticles, the E2H mode has a drastic reduction in the intensity and it might be due to the breakdown of translational crystal symmetry by the incorporated Fe/Ni ions in ZnO matrix. The Ag-doped ZnO nanoparticles produce significant effects on the polar and non-polar branches.

FE-SEM and TEM results of ZnO nanoparticles correlate well with each other and show that the particles are in aggregating nature. Lattice fringe of d-spacing of Mn-doped ZnO samples is around 0.25 nm. These d-spacing values are in good agreement with the standard value of (101) plane, whereas the lattice fringe of d-spacing of Ag-doped ZnO nanoparticles is around 0.28 nm and it matches well with the standard value of (100) plane. The ionic radii of Mn and Ag ions are higher than the Zn ions. The diffraction rings in the SAED pattern clearly indicate that the prepared particles are in polycrystalline nature. From the EDX results of pure ZnO nanoparticles, the presence of Zn and O elements has been identified. Also, the stoichiometric ratios of Mn, Fe, Ni and Ag-doped ZnO nanoparticles are comparatively suitable. N2 isotherm of all the samples corresponds to a type III isotherm in the Brunauer classification. BET and BJH analysis indicates that the surface area and porosity variations of ZnO nanoparticles are mainly due to the incorporation of the dopants and aggregation nature of particles and formation of smaller crystallites.

The data of UV-vis absorption spectra are used to calculate optical band-gap by Kubelka-Munk (K-M) analysis for pure and transition metals doped ZnO nanoparticles. The estimated band-gap values of pure ZnO nanoparticles are from 3.0 to 3.25 eV. The band-gap of Mn and Ag-doped ZnO nanoparticles are obtained around 3.4 and 3.45 eV, respectively. PL spectra of pure ZnO nanoparticles exhibit the strong blue emission (3.11–2.98 eV) corresponding to the exciton recombination related NBE emission. It is also interesting to note that several peaks of blue and green emission are observed on the broad PL spectrum and are related to several intrinsic defects such as Zni, VO, VZn, Oi, OZn and VOZni. These intrinsic defects are responsible for enhanced optoelectronics properties. Moreover, the peaks of blue and green emissions are significantly enhanced by Mn, Fe, Ni, and Ag dopants in ZnO lattices. The emission spectra of pure and transition metals doped ZnO have been analyzed in the framework of CIE 1931 chromaticity. In the pure ZnO nanoparticles, all the calculated chromaticity coordinates appear in the strong blue region. The colour coordinate systems are tuned well with respect to the doping agent and their doping dosage. In the Fe-doped ZnO samples, the colour coordinates are found to fall in strong blue region. The colour coordinates of Ni and Ag-doped ZnO nanoparticles appear in the intermediate portion of the green, blue and white regions. In particular, Ag-doped ZnO (0.1 M zinc precursor) nanoparticles in respect of the colour coordinates fall in bright whiter region (shown in Fig 1a) than all other doped samples. The results of chromaticity diagram show several interesting properties toward practical application in next-generation colour displays and solid state lighting.

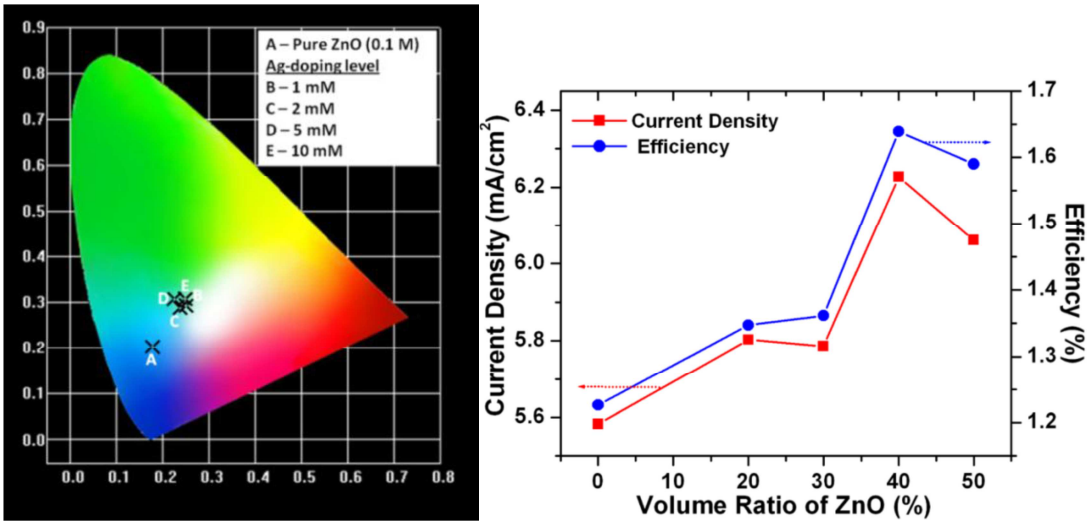


Figure 1: (a) IE colour coordinate diagram of pure and Ag-doped and (b) ZnO nanoparticles based OSC device performance

The dielectrics studies of pure and all the doped ZnO nanoparticles reveal that the dielectric constants and dielectric loss are in accordance with the normal dielectric behaviour of semiconducting materials due to space charge polarization and

grain boundaries related defects. Also, the AC conductivity increases with increase in frequency for all the samples. The dielectric constant, dielectric loss and AC conductivity get decreased in the all doped ZnO samples than pure ZnO. Secondary phase in ZnO and the higher ionic radius of doping materials play a major role in causing the variation in dielectric constant/loss and AC conductivity.
Figure 1b shows the ZnO nanoparticles based OSC device performance. The incorporation of pure ZnO nanoparticles in the active layer improves the PCEs of the solar cell from 1.23 % to 1.64 % with increment about 34 % than reference sample. This improvement was obtained by incorporation of 40 volume % of the ZnO nanoparticles inside P3HT:PCBM solar cell active layer. The JSC and VOC also increased when the doping level of ZnO nanoparticles was 40 volume % in the solar cell active layer. The key point of this study is to bring out that the influence of ZnO nanoparticles in the active layer.

44. To develop air pollutant sensors to reduce genotoxicity using Pd-MoS2 thin films: V. Nirupama*, Sree Vidyanikethan Engineering College, A. Rangampet, Tirupati-A.P

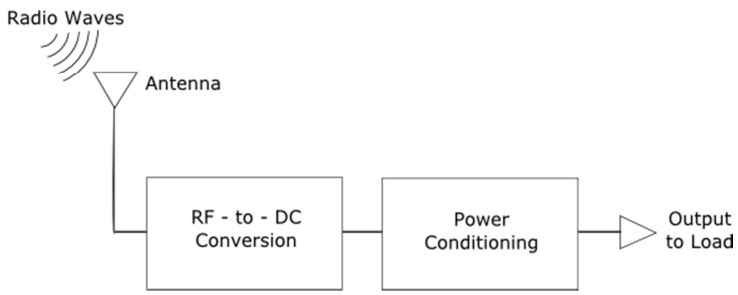
Air pollution can be generated by natural and mobile sources mainly from combustion of fossil fuels. Hence it is mandatory to monitor the levels of air gases and their subsequent effect on human health. In order to detect the gases and reduce the effect on human health, it is required to develop a selective sensor using a two-dimensional (2D) layered materials. Among the 2D family, MoS_2 has unique properties such as electronic, mechanical, physio-chemical, optoelectronic and catalytic. Due to these properties 2D MoS_2 has immense research regarding material's fundamentals, applications, and more recently, its potential for biosensing. However many challenges such as structure / morphology, thickness and quality of the films remain to be overcome in realizing the potential applications. Hence chemical vapor deposition (CVD) is one of the most successful ways to develop 2D MoS_2 thin films. The aim of the present work, developing Pd doped 2D MoS_2 based biosensors and detection of air pollutants in urban areas that cause cancer.
Objectives of the Research Work:

- Preparation of Pd doped MoS_2 thin films using chemical vapor deposition technique.
- Characterization of the Pd doped MoS_2 thin films to know the composition, thickness and morphology
- Optimization of deposition parameters to achieve stoichiometric MoS_2 films and Pd doped MoS_2 thin films.
- Testing the sensitivity of optimized films for air pollutants
- Choosing two different sites (i.e tirupati and chittoor) based on agriculture
- Two types of in situ monitors to be developed

Further evaluate the relation between air pollutants and genatoxic risks.

45. Harvesting Maximum Electrical Energy from long range Radio Frequencies: Nishi Chandra*, Dayananda Sagar University Bengaluru Karnataka

The obvious appeal of harvesting ambient RF energy is that it is essentially "free" energy. The number of radio transmitters, especially for mobile base stations and handsets, continues to increase. ABI Research and iSupply estimate the number of mobile phone subscriptions has recently surpassed 5 billion, and the ITU estimates there are over 1 billion subscriptions for mobile broadband. Mobile phones represent a large source of transmitters from which to harvest RF energy, and will potentially enable users to provide power-on-demand for a variety of close range sensing applications. Also, consider the number of WiFi routers and wireless end devices such as laptops. In some urban environments, it is possible to literally detect hundreds of WiFi access points from a single location. At short range, such as within the same room, it is possible to harvest a tiny amount of energy from a typical WiFi router transmitting at a power level of 50 to 100 mW. For longer-range operation, larger antennas with higher gain are needed for practical harvesting of RF energy from mobile base stations and broadcast radio towers.



Though there are some limitations with this technology. Two of the most common aspects of limitations are
1. Amount of electrical energy can be harvested is very low
2. Source frequency distance is very limited
An important performance aspect of an RF energy harvester is the ability to maintain RF-to-DC conversion efficiency over a wide range of operating conditions, including variations of input power and output load resistance. For example, Powercast's RF energy-harvesting components do not require additional energy-consuming circuitry for maximum power point tracking (MPPT) as is required with other energy-harvesting technologies. Powercast's components maintain high RF-to-DC conversion efficiency over a wide operating range that enables scalability across applications and devices. RF energy-harvesting circuits that can accommodate multi-band or wideband frequency ranges, and automatic frequency tuning, will further increase the power output, potentially expand mobility options, and simplify installation.
The main of this study is to consume maximum electrical energy from any type of RF by designing an improved product which can effectively amplify the unused RF, increased sensitivity of passive receivers for RF harvesting, using Ultra-wideband antennas that can receive a variety of signals in different frequency ranges and converting the RF to maximum electrical energy.

46. Novel Graphene Quantum Dot for Sensing Applications: Pavithra V R*, T. Daniel Thangadurai, Department of Nanoscience and Technology, Sri Ramakrishna Engineering College, Coimbatore 641 022, Tamilnadu, India, email-id: pavithra.ravi01@gmail.com

Nanotechnology and Nanomaterials is now being an innovative tool for environmental remediation and health problems due to significant properties of nano scale materials than bulk. Carbon based materials are easily available but in the other hand major part of the environmental pollution is due to the oxides of carbon. Carbon quantum dot (CQD) and graphene quantum dot (GQD) shows very good optoelectronic and photoluminescence properties and can be functionalized, tuned according to the requirement. In recent years graphene and its quantum dots are used to sense cancer cells, pH, uric acid, xanthine, caffeine, blood serum etc.,. [1] Our aim is to detect hazardous metals, pollutants and biomolecules by using carbon based materials for environmental and health care applications [2-4].

Graphene Oxide was prepared by modified hummer's method [5] and GQD was prepared using GO. In-situ functionalization of GO was also carried out to obtain functionalized graphene quantum dot (FGQD) [3]. Synthesized materials were characterized by X-ray Diffractometer, ATR-FTIR, UV-visible and Photoluminescence spectroscopy techniques available in the institution. Particle size was determined using Zeta potential analyzer and morphology was analyzed by HR-TEM images.

The synthesized GQD compounds were found to have low toxicity and excellent biocompatibility, indicating that they are promising tool for biological applications [6]. Synthesized FGQDs are found to be fluorescent and shows diverse set of absorption and emission peaks. FGQD is being tested with many biomolecule and pollutants. Functionalizations of GQD with different functional groups are under progress in our laboratory.
Key words: GQD, optoelectronic, photoluminescence, FGQD, low toxicity, biocompatibility,
References:

1. M. Amal Raj, S. Abraham John, Simultaneous determination of uric acid, Xanthine, hypoxanthine and caffeine in human blood serum and urine samples using electrochemically reduced graphene oxide modified electrode, *Anal. Chim. Acta* 771, 14-20 (2013).
2. R. Roy, D. Sen, M. Nilesh, S. Saha, Amino functionalized graphene quantum dots: origin of tunable heterogeneous photoluminescence, *Nanoscale* 6, 3384-3391 (2014).
3. G. Bharathi, D. Nataraj, S. Premkumar, M. Sowmiya, K. Senthilkumar, T. Daniel Thangadurai, O.Y Khyzhun, M. Gupta, D. Phase, N. Patra, S. Nath Jha & D. Bhattacharyya, Graphene Quantum Dot Solid Sheets: Strong blue-light-emitting & photocurrent-producing bandgap-opened nanostructures, *Nature* S*cientific Reports* 7, 10850-10867 (2017).
4. P. Russo, A. Hu, G. Compagnini, W. Walter, Duleyd, N.Y. Zhoua, Femtosecond laser ablation of highly oriented pyrolytic graphite: a green route for large-scale production of porous graphene and graphene quantum dots, *Nanoscale* 6, 2381-2389 (2014).
5. B. Paulchamy, G. Arthi and B.D. Lignesh, A Simple Approach to Stepwise Synthesis of Graphene Oxide, *Nanomedicine & Nanotechnology* 6, 253-257 (2015).

Y. Sun, S. Wang, Chun Li, Peihui Luo, Lei Tao, Yen Wei and Gaoquan Shi, Large scale preparation of graphene quantum dots from graphite with tunable fluorescence properties, *Phys. Chem. Chem. Phys*, 15, 9907-9913 (2013).

47. Novel Nanocomposites Coating for Biofouling Prevention: Narendhar Chandrasekar, Steffi Alexander*, Prakash Natarajan, Department of Nanoscience and Technology, Sri Ramakrishna Engineering College, Coimbatore 641022

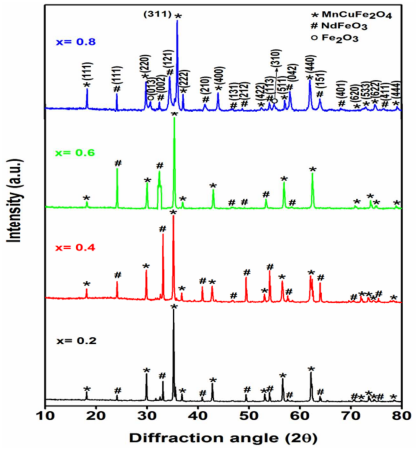
Marine biofouling is a worldwide problem that affects the marine based industries. Marine biofouling which is the undesirable growth of micro algae on wet surfaces, that causes enormous chaos in the maintenance of ships and can accelerate corrosion of that material. Countries worldwide are spending billions to fight against biofouling. It causes serious impact on all marine industries. They take concern about this issue and do work for the preventive measures. In present study, a Novel nanocomposite coating was developed and their antifouling activities were evaluated. For the effective strategy we treat this problem in an eco-friendly manner, use of toxic composites which may affect the marine lives so by using CNSL, TiO_2, teflon etc which won't disturb their habitat, where in detail the cashew nut oil (CNSL) is not harmful for aquatic lives and which wont't harm their environmental habitat. TiO_2 performs as a photocatalyst and using teflon increases the hydrophobic nature of the material, so it is difficult for the marine algae to adhere on to the coated surface. By using all these nanocomposites, we aim to develop an eco-friendly paint by using non toxic, majorly naturally sourced material for preventing algal adhesion onto metal surfaces. This procedure has been postulated to prepare effective and novel coatings for prevention of biofouling.
KEYWORDS: BIOFOULING, NANOCOMPOSITES, CNSL, TiO_2, TEFLON.

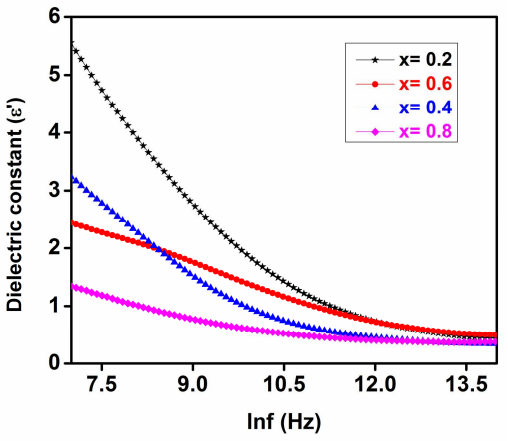
48. Pulsed 70 kV X-ray sensing behavior of ZnO nanorods: Praveenkumar P*, T. Subashini, A. Stephen and T Prakash, National Centre for Nanoscience and Nanotechnology, University of Madras, Guindy Campus, Chennai, Tamil Nadu 600 025, Department of Nuclear Physics, University of Madras, Guindy Campus, Chennai, Tamil Nadu 600 025, Email: thanigaiprakash@gmail.com

X-ray photoconductors are widely used in flat panel x-ray detectors in medical and dental imaging systems. In the present work, x-ray photoconductivity measurement for thick films of ZnO nanorods was performed using real-time intra oral x-ray machine. Prior to the measurement, Nanorods of ZnO were synthesized by simple solid state thermal decomposition method using zinc acetate as a precursor and characterized using powder x-ray diffraction (XRD) and transmission electron microscope (TEM). The analysis confirms the formation of the sample in hexagonal phase with rods morphology. Thick films of ZnO nanorods on the top of tin coated copper digitized electrodes were coated using screen printing process. The resistance of nanorods ZnO thick films at dark and illumination of pulsed 70 kV x-ray was measured for various exposure durations from 0.06 sec to 3.2 sec using an interfaced with Keithley 2450 source meter. Appreciable sensitivity of ZnO nanorods against pulsed 70 kV x-ray explores the possibility of utilizing it as x-ray photoconductor for flat panel x-ray imaging detectors these results will be discussed in detail.
Keywords: ZnO nanorods; Pulsed 70 kV x-ray; X-ray photoconductor; Flat panel x-ray image detectors

49. Doping effect of Nd^{3+} on structural, optical, dielectric and magnetic properties of Mn-Cu nanoferrites: . Rajesh Kanna*, N. Lenin, E. Ahilandeswari, M. Sivabharathy, K. Sakthipandi* , Department of Physics, Sethu Institute of Technology, Kariapatti 626 115, Tamil Nadu, India

Mixed manganese–neodymium–copper nanoferrites having series $Mn_{1-x}Cu_xFe_{1.85}Nd_{0.15}O_4$ (x= 0.2, 0.4, 0.6 and 0.8) were synthesized by the sonochemical method. The structural properties of the nanoferrites explored using X-ray diffraction (XRD). The XRD pattern had a cubic spinel structure and lattice parameters were obtained from XRD spectra. Fourier transforms infrared spectra were used to characterize the chemical bond of tetrahedral and octahedral sites in the spinel ferrites. The surface morphology and elemental composition were analyzed by scanning electron microscopy and energy-dispersive X-ray spectroscopy which suggest that prepared nanoferrites are in spherical shape elongated agglomeration with desired elemental peak. The optical properties were investigated through the optical bandgap of the ferrite using Ultraviolet-diffused reflectance spectroscopy. The bandgap energies were enhanced with inclusion of the Nd^{3+} ions. Dielectric parameters (dielectric constant, dielectric loss tangent and complex dielectric constant) were decreased with an increase in frequency, which is observed dielectric measurement at a wide range of frequency (1 KHz to 5 MHz). The relatively low AC conductivity values for the neodymium doped Mn-Cu nanoferrites. The magnetic behavior was obtained from vibrating sample magnetometer at room temperature. Saturation magnetization (43.88- 24.31 emu/g) decreases with an increase in Cu^{2+} ions. The M-H curve shows that the low coercivity which gives nanoferrites had a soft magnetic material with ferromagnetic nature. The optical, dielectric and magnetic results of the $Mn_{0.2}Cu_{0.8}Fe_{1.85}Nd_{0.15}O_4$ point out that the prepared nanoferrites applicable to the electronic devices in super high frequency.
Keywords: Nanoferrites, Optical bandgap, Dielectric measurements, Ferromagnetism





XRD of the Nanoferrites Dielectric study of nanoferrites

Reference

1. H. Liu, J. Wu, Q. Zhuang, A. Dang, T. Li, T. Zhao, Preparation and the electromagnetic interference shielding in the X-band of carbon foams with Ni-Zn ferrite additive, Journal of the European Ceramic Society 36 (16) (2016) 3939-3946.
2. Z. Zhao, Y. Zhou, C. Zhang, Z. Wang, Thermoset composites functionalized with carbon nanofiber sheets for EMI shielding, Journal of Applied Polymer Science 132 (2015) 41873–41878.

Imran sadiq, Imran han, Evgeny V. Rebrov, M. N. Ashiq, S. Naseem, M. U. Rana, Structural, infrared, magnetic and microwave absorption properties of rare earth doped X-type hexagonal nanoferrites, Journal of Alloys and Compounds 570 (2013) 7–13.

50. Rajeswari G*, Sri Sarada College for Women, Salem, Tamil Nadu

Dye-sensitized solar cell (DSSC) attracts immense interest in the last few decades due to its various attractive features such as low production cost, ease of fabrication and relatively high conversion efficiency, which make it a strong competitor to the conventional silicon-based solar cell.DSCs perform also relatively better compared with other solar cell technologies under diffuse light conditions and at higher temperatures. DSCs offer the possibilities to design solar cells with a large flexibility in shape, color, and transparency. Integration into different products opens up new commercial opportunities.

A DSSC consists of a photoanode, which is made up of a wide band gap semiconductor (TiO_2, SnO_2, ZnO, etc) with a monolayer of dye molecule adsorbed on it, an electrolyte (tri-iodide and iodide redox couple) and a conductive substrate coated with a catalyst (Pt, carbon, etc) as cathode.

Photoanode:

In DSSC, photo-anode performs two important functions, viz. governs the collection and transportation of photo-excited electrons from dye to external circuit as well as acts as a scaffold layer for dye adsorption. The photo-anode usually consists of wide band gap semiconducting metal oxides such as titanium dioxide (TiO_2) and zinc oxide (ZnO) deposited on the transparent conducting oxide substrates.The morphology and composition of the semiconductor oxides have significant impact on the DSSC photovoltaic performance. Therefore, enormous research efforts have been undertaken to investigate the influences of photo-anode modifications on DSSC performance. The modifications can be classified into three categories, namely interfacial modification through the introduction of blocking and scattering layer, doping with non-metallic anions and metallic cations and replacing the conventional mesoporous semiconducting metal oxide films with one-dimensional or two-dimensional nanostructures.

Sensitizer:

Dye sensitizers serve as the solar energy absorber in DSC, whoseproprieties will have much effect on the light harvesting efficiency andthe overall photoelectric conversion efficiency. The ideal sensitizer fordye-sensitized solar cells should absorb all light just below a thresholdwavelength of 920 nm and firmly grafted to the semiconductor oxidesurface and inject electrons to the conduction band with a quantumyield of unity.Its redox potential should be sufficiently highthat it can be regenerated rapidly via electron donation from theelectrolyte or a hole conductor.

An efficient photosensitizer should have certain properties as follows:

1. Show excellent absorption in the visible region (400nm to 700nm).
2. Adsorb strongly on the surface of the semiconductor.
3. Has a high extinction coefficient,
4. Be stable in its oxidized form allowing it to be reduced by anelectrolyte.
5. Be stable enough to carry out ∼108 turnovers, which typicallycorrespond to 20 years of cell operation.

6. Possess more negative LUMO than the CB of the semiconductorand more positive HOMO than the redox potential of theelectrolyte.

In general there are three classes of photosensitizers: metal-free organic sensitizers, natural sensitizers and metal complex sensitizers

Electrolyte:

The purpose of the electrolyte is to regenerate the dye after it inject electrons into the conduction band of the semiconductor. It also acts as a charge passage medium to transfer positive charges toward the counter electrodes. The long-functional life time stability of DSSCs strongly depends on the properties of electrolyte. Thus, the electrolyte must have the following characteristic.

1. Excellent electrical conductivity and low viscosity for faster diffusion of electrons.
2. Good interfacial contact with the nanocrystallinesemiconductor and the counter electrode.
3. It should not be the cause of desorption of the dye from theoxidized surface and the degradation of the dye.
4. It should not absorb light in the visible region.

Electrolytes for DSSCs are classified into three types: solid state electrolytes, liquid electrolytes, and quasi solid state electrolytes.

Counter Electrode:

The counter electrode is used for the regeneration of the electrolyte. The oxidized electrolyte diffuses towards the counter electrode where it receive electrons from the external circuit. A catalyst is needed to accelerate the reduction reaction and platinum (Pt) is considered a preferred catalyst due to its high exchange current density, good catalytic activity, and transparency. The performance of the CE depends on the method of Pt deposition on TCO substrate.

Dyesensitized solar cells have gained widespread attention in recent yearsbecause of their low production costs, easy of fabrication, its lighterweight property, environmentally friend and recyclable advantages andtunable optical properties, such as color and transparency regardless ofits low efficiency output comparing to silicon solar cell. In summary, DSSCs offer sufficient challenges for any materials scientist for further research and fruitful commercialization of this exciting new technology.

51. Ranjithkumar Mohanam*, Sri Venkateswara College of Engineering, Kancheepuram, Sriperambudur, Tamil Nadu

Copper oxides such as, CuO and Cu_2O have a great potential to be an active absorber layer for photovoltaic devices. Copper oxides are naturally existing semiconductor materials that are non - toxic in nature. The availability of starting material copper that can be easily oxidised makes copper oxides a naturally abundant. An investigation into copper oxide and zinc oxide thin films deposited on a glass substrate individually by RF sputter deposition technique at various process parameter is presented in this work. The electrical and optical characteristics were determined by using hall measurement and UV-visible spectroscopy. The experimental result shows that optical bandgap of copper oxide thin films decreases with annealing process and zinc oxide thin films provide better optical transmittance characteristics in visible spectrum proving to be a viable option for solar cell. The bandgap energies of 2.5 eV has been achieved for as-grown CuO, whereas samples grown at higher temperature and on annealing exhibited a red shift in the range of 1.65 - 1.95 eV. Fig. 2 shows the effect of RF power on ZnO thin films deposited at room temperature with deposition duration of 20 minutes. The plot validates good transmittance for ZnO thin films in visible spectrum making ZnO a good semiconductor material choice for solar cell.

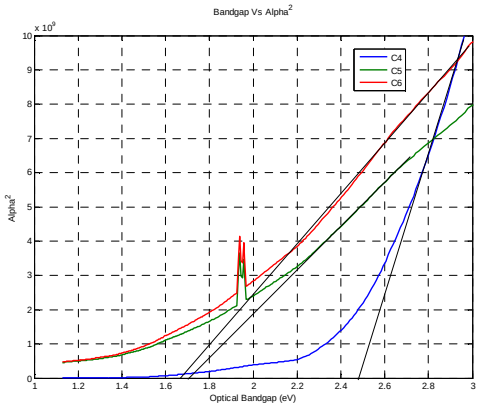


Fig 1: Bandgap vs Alpha^2 for copper oxide samples with annealing

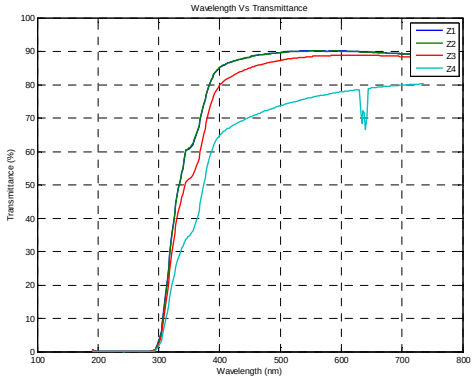


Fig. 2 Optical transmittance of ZnO thin films sputtered at various RF power

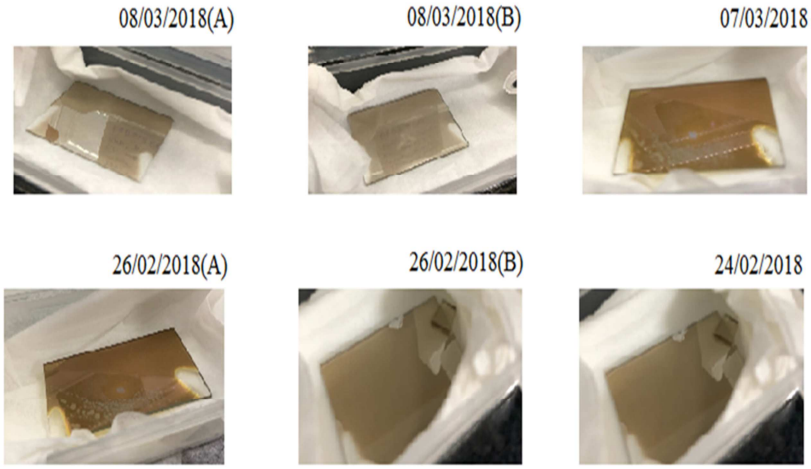


Fig 3: CuO thin film samples on Glass substrate

The preliminary work on materials research shows copper oxide have good absorption at 1.65eV to 2.5eV, and zinc oxide have 90% transmittance in visible spectrum making them a good choice of material for solar cell. The device fabrication will require appropriate contacts for the top and bottom layers to achieve appropriate efficiency for flexible solar cell applications.

52. Synthesis and charactrization of ZnO nanoparticles embeded CNT nanocomposites using solvothermal method: R. Ranjithkumar*, N. Nallamuthu, P. Devendran, M. Krishna Kumar, Department of Physics, International Research Centre, Kalasalingam Academy of Research and Education, Krishnankoil-626126, Tamil Nadu, India.

The high surface area spherical shaped ZnO nanoparticles successfully embedded on single wall carbon nanotube by solvothermal method and hexamine as stabilizing agent. The prepared nanocomposite was studied with various analytical methods like optical, structural, morphological and thermal stability. The surface morphology of ZnO/SW-CNT nanocomposite analysed by scanning electron microscopy (SEM) and elemental composition were confirmed with EDX analysis. Functional group and formation of the ZnO nanocomposites were studied by Fourier transformation infrared spectroscopy (FT-IR), the structure and crystalline of the prepared sample were confirmed by X-ray diffraction (XRD). The ZnO nanocomposites were examined by electrochemical activity. The functionalized SW-CNT with the carboxylic group acids recoils consequence the metal oxides shows unique properties. Functionalize carbon nanotubes with metal oxides impregnation hybrid material for super capacitor and energy applications and the transitional metal oxides embedded-CNT

nanocomposite may becomes next-generation of novel electrode materials for energy storage device application. This proposed method may suggested that simple high purity and large scale production.
Keywords: ZnO/CNT, Hybrid electrode, Solvothermal, Energy storage device, Supercapacitor.

53. Organic-inorganic perovskite CH3NH3PbI3 and ZnO quantum dot Hetrojuction based broad band photo detector: Rishibrind Kumar Upadhyay*, Indian Institute of Technology (BHU) Varanasi, Varanasi, Uttar Pradesh

A photodetector is a device for measuring and detecting the properties of light through photoelectric effect, which is usually manifest as a photocurrent. these days, photoelectric conversion on photodetectors is very much increasing interest in academics, research and industrial area in wide range of applications such as optical communication, environmental monitoring, image analysising and biological application. So materials which absorb incident photons and generates electrons-holes pair upon photo-excitation are consider as active material for photodetection. Mostly for these generation of electrons-holes pair semiconducting materials are used. The various types of semiconductor materials have been applied in photodetectors, such as Si, GaN, GaAs, InGaAs, ZnO, carbon nanotubes and conjugated polymers by researchers but these semiconductor material didn't fulfill all requirement. The goal of research is to design a material system that has the potential to satisfy most of the requirements viz. (a) broad and tuable light absorption (b) efficient free charge-carrier generation (c) low cost for cost-effective Perovskites family comprise various organic-inorganic lead halide structure used in various optoelectronics applications such as Solar Cell, photo-detector etc. Recent studies have reported that organic-inorganic hybrid perovskite based photo-detector have attracted considerable attention in optoelectronic devices due to these materials have many advantages including low cost, high absorption coefficient, high carrier mobility, high power conversion efficiency and direct band gap. CH3NH3PbI3 perovskite structure, has been emerged as one of the promising materials. CH3NH3PbI3 are synthesized via sol-Gel synthesis route. The prepared CH3NH3PbI3 are characterized by X-ray diffraction (XRD) and efficient PL band is observed at ~1.60 eV in CH3NH3PbI3 thin films at room temperature. XRD result confirmed the formation of Tetragonal phase of CH3NH3PbI3 with crystallite size ~ 80 nm. Further, CH3NH3PbI3 active layer are studied for photo-detection application.
Keywords: CH3NH3PbI3, quantum dot, photo-detector

54. Investigating optical and electrical properties of porphyrin modified $BaSnO_3$ microrods for photovoltaic applications: Shalu Sharma and Sandeep Chhoker*, Department of Physics and Material Science and Engineering, Jaypee Institute of Information Technology, Noida, Gautam Buddha Nagar, India-201307, Corresponding Author Email: sandeep.chhoker@jiit.ac.in

The increased use of solar technology for next generation power resource demands developing new materials for strong visible range performance. Here, we have investigated the strong correlation between electrical and optical properties of barium stannate microrods with vacuum, air and oxygen annealing and further with simple heterocyclic molecules of porphyrin. The uniform sized (10-15 μm) micro-rods were synthesized via simple chemical precipitation method at 120^{o}C and are observed in Scanning electron microscopy. X-ray photoelectron spectroscopy confirms the role of O 1s in mediating room temperature electrical transport properties for micro-rods annealed at temperature 200-400^{o}C under different conditions. The optical (Uv-Vis) and impedance spectroscopy of zinc tetraphenyl porphyrin (ZnTPP) modified microrods via liquid adsorption method have been carried out. It was established that using ZnTPP and also in combination of other similar porphyrin types (e.g. MgTPP, Fe-ClTPP, NiTPP etc.) results in larger visible range sensitization (~470-630 nm) via simple surface adsorption method due to presence of Q-band besides its usual strong Soret band in 400-450 nm range.
Keywords: $BaSnO_3$, porphyrin dyes, XPS, Uv-Vis

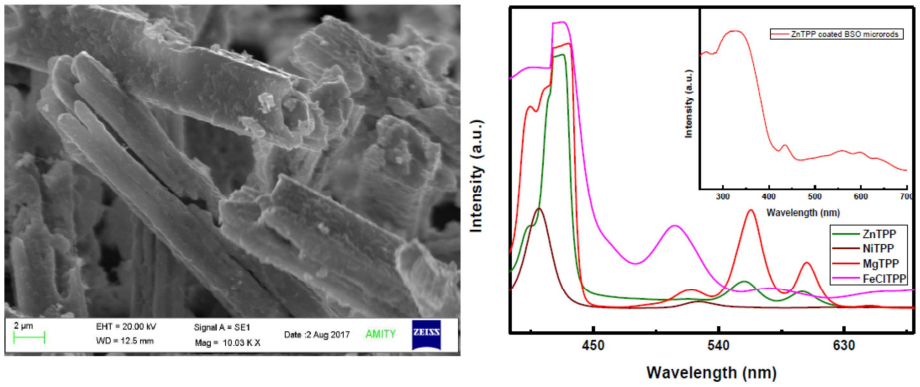


Fig. FESEM of BSO microrods and Uv-Vis of different porphyrin (in ethanol at 10^{-6} mMol solution);

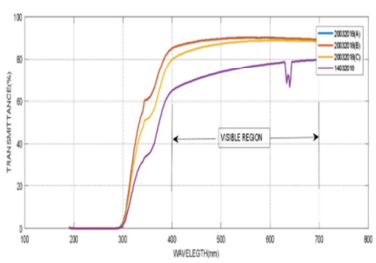
Inset shows Uv-Vis of ZnTPP modified BSO microrods

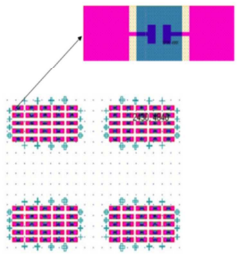
55. Study of Structural & Molecular Behavior of Binary Liquids Using Time Domain Reflectometry (Spectroscopic) Technique: Mr. S. S. Birajdar*, Department of Physics and Electronics, Maharashtra Udaygiri Mahavidyalaya, Udgir, Maharashtra (INDIA)

The study of structural behavior, dielectric relaxation and molecular interaction in binary mixtures of chlorobenzene with methanol has been carried out at various temperatures and 11 different concentrations using TDR. The molecular interaction of solute-solvent mixture in the microwave frequency range of 10MHz to 30 GHz gives information about the information of monomers and multimers as well as interaction between the molecules of the given binary mixtures. The structural parameters viz. static dielectric constant and relaxation time have been obtained by the least squares fit method using Debye equation characterized by a single relaxation time without relaxation time distribution.
Keywords- Static dielectric constant; Relaxation time; Excess properties; Microwave dielectric technique.

56. Fabrication and characterization of ZnO/MoS2 Thin Film Transistor: M. Sasikala*, Dr. Sudhakar KB, Sri Venkateswara College of Engineering, Kancheepuram, Sriperambudur, Tamil Nadu

Thin film transistors (TFT) are key elements in flexible electronics, with prominent application the pixel switching elements on flat panel displays. Transparent amorphous oxide semiconductor materials enabling faster TFTs, holds promise of expanding TFT application to full systems-on-panel, for increased reliability and lower production costs. Currently, indium-rich Indium tin oxide (ITO) is the widely used TCO in various fields of application such as, optoelectronics, flexible electronics, and organic LEDs. Due to the high cost of indium (main component of ITO) and its scarcity, alternative indium-free TCOs are required. The objective of this project to will be to experimentally investigate microstructure, optical, absorption and electrical properties of an alternative material system and also fabricate thin film transistor using RF sputtering, photolithography process, metal deposition and film annealing. ZnO is one of the material has the potential to exhibit comparable results to ITO films. Low cost deposition and their experimental performance will lead to the extension of oxide semiconductor from the present flat panel displays to photovoltaics, which can potentially replace conventional silicon. ZnO is a direct bandgap semiconductor material (3.3 eV at 300K), which has potential applications in optoelectronic applications. The large exciton binding energy (60 meV), large availability of Zinc in the earth's crust as compared to other alternate materials, simpler growth techniques to produce ZnO bulk crystals, are the major advantages, which can result in low- cost ZnO-based devices.
In addition to flexible electronics, ZnO based devices find its application in Photodetectors. Spectral responsivity can be increased by adding the two dimensional dichalcogenide (TMD) semiconductor.
The Preliminary work has been started with the deposition ZnO thin films using RF sputtering and transmittance 90% has been achieved for RF power of 70W. To fabricate TFT, the mask design has been done and picture of ZnO deposited on oxidized silicon wafer is shown below.



ZnO Transmittance ZnO deposited samples Mask layout

The project will involve electrical and structural characterization of ZnO/MoS2 TFT (Thin Film Transistor) using appropriate testing methods. The variation of device parameters as function of thickness of the ZnO and W/L ratios will be the subjects of study.

57. Enhanced Electrochemical Performance of TiO2 Nanosheets Based Electrode for Aqueous Supercapacitor Applications: Shashank Sundriyal*, Vishal Shrivastav, Sunita Mishra and Akash Deep, Academy of Scientific and Innovative Research (AcSIR-CSIO), Chandigarh 160030, India, CSIR-Central Scientific Instrument Organisation (CSIR-CSIO), Chandigarh 160030, India, Corresponding author: dr.akashdeep@csio.res.in; sunita_mishra@csio.res.in

The requirement of clean and green energy motivates researchers to opt for alternative energy storage devices. Among them supercapacitors and batteries are gaining popularity due to their superior electrochemical performance. Due to very high specific capacitance, high power density and long cycle life supercapacitors are becoming a primary choice for upcoming energy storage devices. The performance of supercapacitors mainly relies on the suitable choice of active electrode material [1]. Therefore, in this context metal oxides like MnO2, RuO2, TiO2, ZrO2 etc. are gaining more research interest due to their extremely high pseudocapacitance which helps to achieve a high value of energy and power density. In this paper, we have synthesized TiO2 nanosheets using one-pot hydrothermal approach [3]. The TiO2 nanosheets facilitates the optimized ratio of micropores and mesopores which remarkably increases the specific surface area. Further, the TiO2 nanosheets are used as an electrode for supercapacitor applications. When the TiO2 NS electrode is tested in 1M Na2SO4 aqueous electrolyte, the electrode shows a high specific capacitance of 80.64 F/g at a current density of 0.5 A/g. Also, the electrode is used to achieve a moderate energy density of 11.20 Wh/kg at a power density of 256.67 W/kg. Such remarkable values of specific capacitance and energy density is attributed with the optimized ratio of micropores and mesopores which facilitates fast transport of electrolyte ions into the pores of active TiO2 NS electrode. The obtained values for specific capacitance and energy density for TiO2 NS electrode motivates to tune the morphology of different pseudocapacitive electrode materials for practical supercapacitor applications [2].

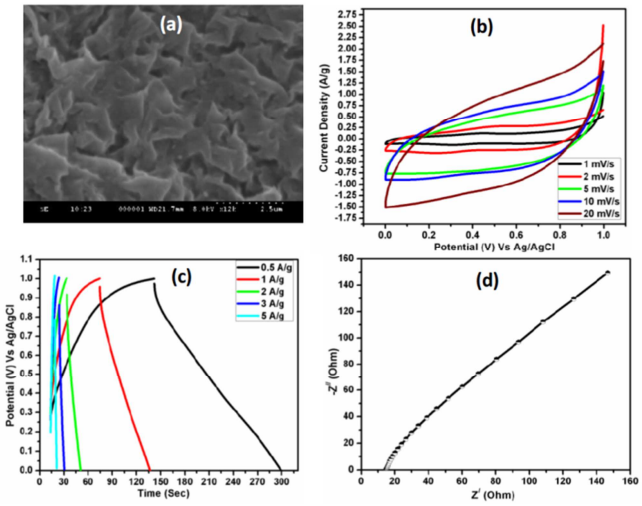


Figure Electrochemical performance of TiO2 Nanosheets electrode: (a) FESEM image, (b) CV curves at various scan rates, (c) GCD curves at various current densities, and (d) Nyquist plot at a frequency range of 0.1 Hz to 100 KHz.

References:

[1] P Simon, Y Gogotsi (2008) Nature materials 7: 845.
[2] C Xiang, M Li, M Zhi, A Manivannan, N Wu (2012) Journal of Materials Chemistry 22: 19161.
[3] W Wang, Z Wang, J Liu, et al. (2017) Scientific Reports 7.

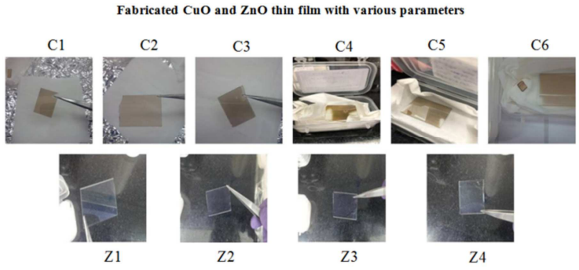
58. Synthesis of Iron and Iron-sulfide Nanoparticles by Green Approach using Extract of Urtica Dioica: Shubhra Kala*, Anju Nigam, Department of Physics, BCC campus, H.N.B. Garhwal (a central) University, Srinagar Garhwal-246174, Email: shubkala@gmail.com

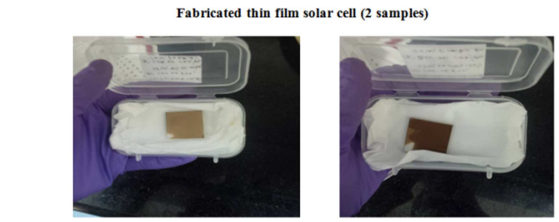
Synthesis of nanoparticles using “green” approach has vastly been utilized to test various antibacterial and antimicrobial activities. However, the applicability of these nanoparticles in terms of physical properties has not been explored much. Iron (Fe) nanoparticles are widely used as nano-sorbents and photo-catalysts; moreover, it can also be relevant in optoelectronic applications. In the present work, we have used a simple green method to synthesize iron nanoparticles. The green approach is environment friendly and non-toxic. The leaves of *Urtica Dioica* were used to prepare extract, which reduces $FeCl_3$ solution in order to prepare iron nanoparticles. In present methodology, we have taken 10 gm of dried leaves of Urtica Dioica and moderately heated in 100 ml double distilled water for 30 minutes and left for cooling at room temperature and then finally filtered twice. The obtained extract was mixed in definite ratio with already prepared salt solution of Iron Chloride of varied molarities of 0.1-0.001 M. The resulting solution was then kept in dark. The absorption spectra of resulting solution were recorded by ultraviolet- visible spectrophotometer. The absorption peak was observed at 419 nm wavelength, indicating presence of Fe nanoparticles. By centrifugal, Fe nanoparticles were separated out from the solution and then dried. Systematic studies about the yield of nanoparticles depending on different parameters were carried

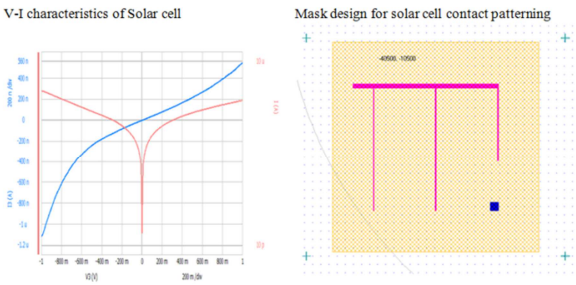
out. Similar approach has been utilized to prepare iron sulfide nanoparticle with additional inclusion of sulfur source. The prepared Fe nanoparticles were found in the size range of 15 to 56 nm, while iron sulfide nanoparticles were of the size 15 nm to 66 nm. Iron and iron nanoparticles were also characterized by XRD and SEM/TEM to investigate structure and morphology of prepared nanoparticles, respectively.
Keywords: Urtica Dioica, nanoparticles, iron and iron sulfide

59. Modelling and Fabrication of Thin Film Solar Cell: Sinthamani Sivaprakasam*, Sri Venkateswara College of Engineering, Kancheepuram, Sriperambudur, Tamil Nadu

Recently, numerous researchers have shown interest in the characteristics of metal oxide semiconducting for potential applications in solar cell. The suitability of CuO as active absorber layer for photovoltaic devices and we have tried to optimise the deposition parameter of CuO thin film using RF magnetron sputtering. Copper oxides are naturally existing semiconductor materials that are non - toxic. The availability of starting material copper that can be easily oxidised makes copper oxides a naturally abundant. The band gap energy for copper oxides is reported to be ranging between 1.3 - 2.1 eV for CuO and 2.1 – 2.6 eV for Cu_2O. Zinc oxide (ZnO) which has band gap energy of 3.37 eV can be used as transparent conductive oxide.
The current work focuses on fabrication of solar cell on different substrate using DC and RF magnetron sputtering. An investigation into copper oxide and zinc oxide thin films deposited on a glass substrate and FTO coated substrate individually by RF sputtering at various process parameters were observed. The electrical and optical characteristics were determined by using hall measurement and UV-visible spectroscopy. The experimental result shows that optical band gap of copper oxide thin films decreases with annealing process and zinc oxide thin films provide better optical transmittance characteristics in visible spectrum proving to be a good choice of material for solar cell fabrication. After optimization of thin film flexible single junction photovoltaic cell is fabricated using CuO/ZnO thin film by RF sputtering deposition method. The structure of the fabricated solar cell is shown below.
V-I Characterization is done using Cascade Microtech Summit 11000 M – automated probe system. The mask design with 3-5-9 finger configurations will be implemented.



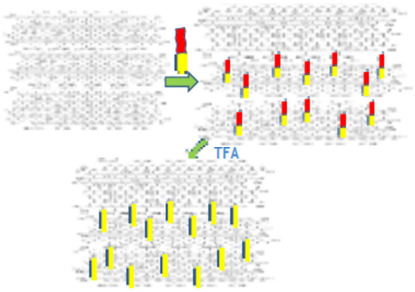




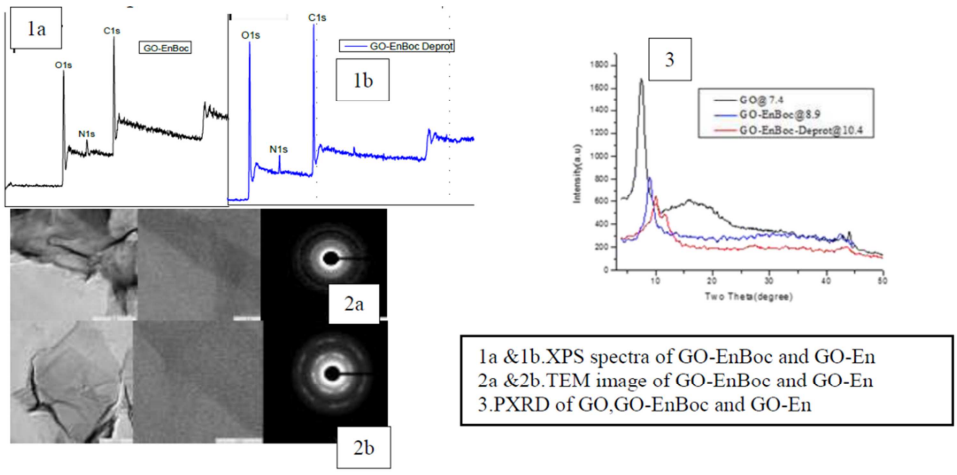
The over arching goal of this project is to determine the appropriate contacts for CuO and ZnO active layers. Before finding the efficiency the significance of different front and back contacts will be studied in detail for solar cells. In thin film devices, such as solar cells, optoelectronics and thin film transistor, the main contributor to high parasitic losses is the contact resistance between metal electrodes and active semiconductor materials.

Further performance improvements in these devices are only possible by reducing the contact resistance. Contact resistance has been a major issue in most of the devices, and as a result of contact resistance, the system will perform with losses in electrical, thermal and mechanical properties.
The contact resistance differs in cases where bulk materials are utilized in devices, as in the case when devices and contacts are formed between thin films. By selecting appropriate contact materials (Ag, Au, Al, compound materials) ohmic contacts will be made and the contact resistance will be measured using four probe measurement technique.

60. Jacky module: Intercaltion of Graphene Oxide with N-Boc Ethylenediamine and Shrinked Boc deprotected Ethylene diamine fuctionalised Graphene Oxide: Srinivasan A*., Bhalerao G.and Jebasingh B, Department of Chemistry, Karunya University, Coimbatore-641 114, TN, INDIA, UGC-DAE-CSR, Kalpakkam Node, IGCAR-Kalpakkam,- 600 109, TN, INDIA



N-Boc ethylene diamine was functionalized on the Graphene oxide covalently where the interlayer distance was increased from 8.9Å to 14 Å and 2θ value is decreased from 8.9o to 7.4o. Deprotection of functionalized N-Boc ethylene diamine Graphene oxide interlayer distance was decreased from 14 Å to 10.4 Å where *t*-butyl group was removed by treating with trifluoroacetic acid. GO-En-Boc and GO-En materials were characterized by Powder XRD, TEM, TGA, XPS, 13C-NMR, IR and Raman spectroscopy. In IR spectroscopy, GO-EnBoc has wavenumber at 1740cm-1 which is amide group absent in GO-En. In XPS spectra show the presence of N functionalization on the surface of the GO. In the XPS spectra, the three characteristic peaks around 280, 401 and 530 eV corresponding to the C1s, N1s and O1s binding energies respectively.
The four different peaks centered at 283.99, 285.93, 287.6 and 289.82 corresponds to the binding atoms related with C=C/C-C in the aliphatic, C-O in the Secondary alcohol, C=O in the terminal acid carbonyls and O=C-O in the terminal acids, respectively. The 13CNMR solid state spectroscopy, GO-EnBoc spectrum has δ values of 29.58 and 160 ppm for *t* butyl alkyl carbon and carbonyl group of amide carbon and those peaks are disappeared in GO-EnBoc which implies the N-Boc group of the surface functionalized GO was deprotected from the GO-EnBoc.



1a &1b.XPS spectra of GO-EnBoc and GO-En
2a &2b.TEM image of GO-EnBoc and GO-En
3.PXRD of GO,GO-EnBoc and GO-En

61. Synthesis, characterization and enhance the dispersion stability of metal oxide composites Nano fluids for heat transfer applications: S.Srinivasan*, Department of Physics, Presidency College, Chennai 600005, Tamil Nadu, India.Email: srini.140375@gmail.com

Nanofluids offer a promising solution for heat transfer enhancement and highly suitable for practical heat transfer process applications nowadays. Nanofluids are a class of new coolants prepared by dispersing nanomaterials with high thermal conductivity in the base fluids such as water, ethylene glycol, propylene glycol, mineral oil and transformer oil, etc.

The present works aimed to synthesis, preparation and studies on thermos-physical properties of electrospun metal oxide nanocomposites for heat transfer applications. The production of nanostructured materials at a large scale at lab can be easily done through by means electrospinning techniques. Electrospinning process yield one dimensional nanostructured materials in the form of fibers at large scale. We made an attempt to prepare metal oxide such as ZnO, TiO_2, and SnO_2 nanofibers and these metal oxide nanocomposites by electrospinning methods.

The synthesized materials are dispersed in conventional base fluids such as water, ethylene glycol, propylene glycol and its mixtures at various volume percentage to obtain nanofluids by two step procedures.

The prepared solution was stabilized by various methods such as ultrasonication, change pH, using additives, etc. A very good dispersion and stability of the fluids play a key role in achieving good chemical stability and good thermal conductivity. The thermos-physical parameters such as viscosity and thermal conductivity have to be determined from experiments and its performance can be estimated. The optimizing conditions at which better thermal conductivity and stability of the nanofluids system have been proposed in this study for heat transfer applications.

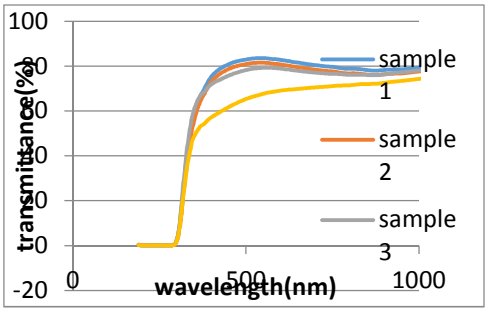
Moreover, optical, electrical, rheological and thermal properties of metal oxide nanocomposites and nanofluids were investigated in the present study.

Keywords: Nanofluids, metal oxide, heat transfer.

62. Sudharsanam S*, Sri Venkateswara College of Engineering, Kancheepuram, Sriperambudur, Tamil Nadu

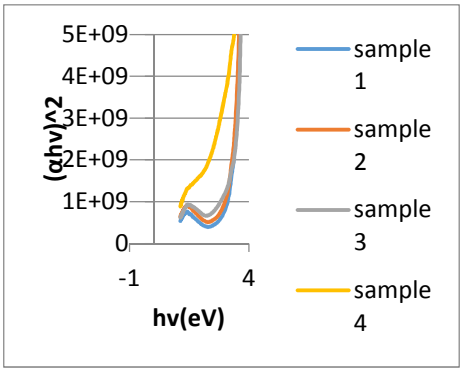
Transition metal dichalcogenides (TMDCs) are an exciting new class of material system which possesses distinctive physical properties when thinned down to atomic layer level. Currently, graphene is the widely researched two-dimensional structure in various fields of application, and certainly, Graphene is not alone in this area of research. The overarching objective of this project will be to investigate microstructure, optical, absorption and electrical properties of an alternative material system, MoS_2, which has the potential to exhibit comparable and/or improved results to graphene films. The structural state of the MoS_2 films will be determined using the combination of XRD and Raman data. The electronic behaviour of the MoS_2 will be determined using different combinations of tools in tandem, such as, Raman spectroscopy and photoluminescence; Raman spectroscopy and absorption measurements (FTIR).

Our preliminary work on MoS2 on Glass substrates using RF sputtering shows promising optical properties such as around 80% transmission and absorption edge varying from 1.2eV to 2.5eV.

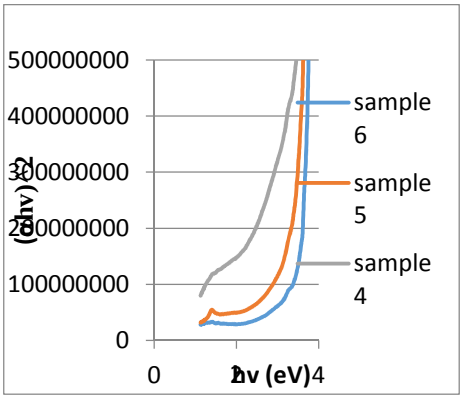


The above graph shows the plot of wavelength(nm) vs transmittance(%) for samples 1,2,3 and 4

Absorption Characteristics



The above graph shows the plot of hv(eV) vs (αhv)^2 for samples 1,2,3 and 4 where α is the absorption coefficient.



The above graph shows the plot for hv(eV) vs (αhv)^2 for samples 4,5 and 6 where α is absorption coefficient.

63. Nanostructured thin films for solar cell applications: T. Shiyani*, T. Bagchi, School of Nanoscience, Central University of Gujarat, Gandhinagar-383030, India. SRI Institute, Rajkot-360003, India. E-mail: tms.sri@outlook.com

Solar energy is the most natural source of energy on the earth. Solar cell is the most efficient device to harness the solar energy for practical applications. The light-to-electrical energy conversion process in photovoltaic devices relies on the separation of electrons and holes. The fundamental physics behind the photovoltaic effect is charge separation using the potential developed at a p-n junction or heterojunction. We have proposed the work on the development of solar cell using semiconductors such as Cu_2ZnSnS_4 (CZTS), TiO_2, ZnO, and graphene; ferroelectric such as $BaTiO_3$ (BTO), ferromagnetic such as $BiFeO_3$ (BFO) and other nanostructured thin films. The bandgap of BFO, CZTS, BTO, ZnO, graphene, TiO_2 thin films are about 2.78 eV, 3.2 eV 1.5 eV, 3.3 eV, 0.25 eV, 3.03 eV, respectively. The thin films of semiconductors will be deposited on FTO, ITO and Mo coated glass substrates using sputtering and electrodeposition method. We have proposed the fabrication of thin film solar cells as well as dye sensitized solar cells using the combination of semiconductor thin films and natural dyes such as tulsi-basil, spinach, etc. Solar cells would use the characterization of solar cells using X-ray diffraction, Raman spectroscopy and scanning electron microscope and solar simulator. CZTS thin films were electrodeposited on Mo and F:SnO2/Glass substrates at room temperature by single step method from an aqueous solution containing tri-sodium citrate and tartaric acid as complexing and pH controlling agents, respectively. Raman spectra showed the existence of crystalline CZTS phase. The post-annealing treatment was carried out in the temperature range 400-600 °C in an Ar-atmosphere to improve the CZTS phase composition and crystallinity. The kesterite CZTS phase grew to larger extent upon annealing at 500 °C. $BiFeO_3$ is a functional material that gives ferromagnetic, ferroelectric and multiferroic properties and it has potential applications for photovoltaic devices. We have proposed a new mechanism of charge separation and photovoltage generation that occurs exclusively at nanometre-scale ferroelectric domain walls in BFO under light illumination. BFO thin films have been used as an absorber for sustainable photovoltaic devices. The combination of various nanomaterials gives better light-to-electrical energy conversion efficiency.

64. Microcellular Biocomposite Bone Scaffolds from Ultrafine Fluorcanasite/Poly-(ε-caprolactone) using combined technique of Particulate Salt Leaching-Freeze Drying: Vijay Shankar Kumawat*, Subrata Bandhu Ghosh, Sanchita Bandyopadhyay-Ghosh, Department of Mechanical Engineering, Manipal University Jaipur, India, vijayshankar.kumawat@jaipur.manipal.edu

INTRODUCTION

Natural healing of bones can sometimes be challenging, especially in the case of massive bone loss. Besides, conventional bone scaffolds are often unable to repair and augment defective bone tissues in an efficient manner[1]. Against this background, continuous development of suitable biomaterials and processing methods is pertinent for develop new generation bone scaffolds with three-dimensional pore structure. The scaffold are expected to mimic the extra cellular matrix to enhance cell seeding, proliferation, and new mineralized bone tissue formation. Traditional bioceramics such as hydroxyapatite (HA), tri-calcium phosphate (TCP), although, are biocompatible, and chemically stable, they possess poor mechanical properties and castability, rendering them unsuitable for load bearing applications[2]. However, previous studies have established that bioactive modified fluorcanasite (FC) glass-ceramic has promising potential as a bone substitute

biomaterial owing to its fluorapatite crystalline phase, outstanding mechanical properties and the unique ability to bulk nucleate.

EXPERIMENTAL METHODS

Synthesis & fabrication of ultrafine-fluorcanasite glass-ceramic/PCL composite scaffolds

Selective engineered glass batch was designed in-house through stoichiometric modification of calcium and phosphorous oxides, while, poly-ε-caprolactone (PCL) was used as polymer matrix to develop composite scaffolds. Initially, modified fluorcanasite glass batch was melted, followed by water fritting. Obtained dry glass frits were mechanically milled in high energy ball mill using ethanol as a process controlling agent to obtain ultra-fine glass particles. Finally glass particles were heat-treated in tabular furnace by adopting two-stage controlled heat-treatment profile to produce FC glass-ceramic. Combined technique of salt leaching and freeze drying has been used to develop a range of composite bone scaffolds with varying porosities, followed by their characterisations.

RESULTS AND DISCUSSION

X-ray diffraction (XRD)

X-ray diffraction (XRD) traces of ultrafine-fluorcansaite glass-ceramics established the presence of formation of frankamenite, fluorcanasite, xonotlite, and fluorapatite crystalline phases.

Scanning electron microscopy (SEM)

SEM results indicated distribution of ultrafine-FC within PCL matrix, along with interconnected microcellular pore networks within composite scaffolds, essential for bone proliferation and cell adhesion.

Fourier transform infrared spectroscopy (FT-IR)

The FT-IR spectra of the samples confirmed the presence of characteristic peaks of ultrafine FC, PCL along with possible interactions between PCL matrix and ultrafine-FC reinforcements.

Micro-indentation of ultrafine-FC

The ultrafine-FC was subjected to micro-indentation test, which resulted into a hardness of 6.8 GPa. This is ~1.7 times higher than the reported literature value of commercial HA (3.9 GPa).

Biodegradation and pH change

Biodegradation and pH studies through incubation of scaffolds in Hank's buffered-salt solution at 37°C, indicated that biodegradation rate of ultrafine-FC/PCL composite scaffold could be tuned by incorporation of ultrafine FC. Further, pH of solution indicated stability at different time intervals.

CONCLUSION

Ultrafine-FC was successfully synthesized, as evidenced by XRD study. Microstructural and functionality studies confirmed the interconnected porous network and interfacial compatibility of PCL and FC reinforcement. Degradability studies indicated that the bio-composite scaffolds were biodegradable and the degradation rate could be tuned upon incorporation of ultrafine FC within PCL matrix. Finally, this study could establish that the novel biodegradable, bioactive composite scaffolds can be used as potential implants for orthopedic applications.

REFERENCES

1. Akkouch, A. et al., J. Biomater. Appl. 28:922-936, 2014.
2. Chang, H.C. et al., Mat. Sci. Eng. C 61:396-410, 2016.
3. Bandyopadhyay-Ghosh, S. et al,. J. Biomed Mater. Res. A 80:175-183, 2007.
4. Liu, X. & Ma, P.X., Biomater. 30:4094-4103, 2009.

ACKNOWLEDGMENTS

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65. Ixora Coccinea L., (Jungel Flame) Leaf Extract Mediated Bioproduction of Silver Metal Nano Particles with Antibacterial Properties: Vinay S P*, Chandrasekhar N, Research and Development Center, Department of Chemistry, Shridevi Institute of Engineering & Technology, Sira Road, Tumakuru - 572106, Karnataka, India. *Corresponding author: Vinay S P. Email: s.pvinay143@gmail.com

The communication describes a green synthesis approach for bioproduction of silver nanoparticles (AgNPs) by leaf concentrate of *Ixora coccinea* as bio-reducing agent. The silver nitrate solution underwent a rapid bioreduction when treated with leaf concentrate of *Ixora coccinea* to generate AgNPs as indicated by the characteristic color change of the solution from light green to reddish brown. The obtained particles were characterized by various characterization techniques and their biological application.

KEYWORDS: Silver nanoparticles, Solution synthesis, SEM, TEM, Antibacterial activity.

66. Visnupriya S*, Sri Sarada College for Women, Salem, Tamil Nadu

The quality of human life depends to a large degree on the availability of energy. Motivated by continuously growing global energy demands and the depletion of readily accessible fossil fuels; the search for alternative energy sources,

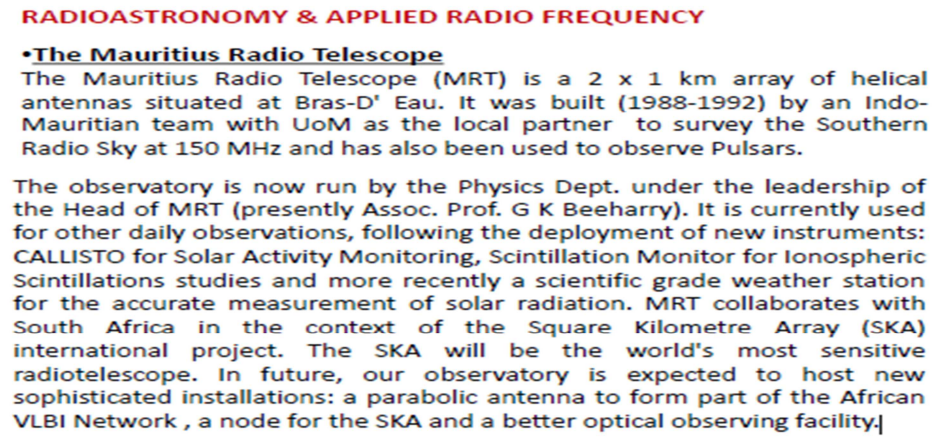
particularly renewable solar energy, has become vital. Despite the clear advantages associated with the adoption of solar cells, they need to be cost-effective and priced competitively in comparison to conventional energy resources, as any technological or performance improvements must be balanced against the associated cost.
Photovoltaics is an empowering technology that allows us to do totally new things, as well as, do old things better. Photovoltaics is the technology that generates direct current (DC) electrical power measured in Watts (W) or kilowatts (kW) from semiconductors when they are illuminated by photons.
The dye-sensitized solar cells provides a technically and economically credible alternative concept to present day p–n junction photovoltaic devices. It is low-cost photovoltaic devices have received widespread attention in recent years, simple manufacturing processes together with their advantageous attributes (e.g. lightweight, flexible, low toxic, and good performance in diverse light conditions. DSSCs consists of four key components such as photo anode, Sensitizer (DYE), Electrolyte and Counter electrode.
DSSC typically consists of a several micron thick semiconductor (e.g. TiO2, ZnO and SnO2) film served as a photo- anode that is coated or grown on a conductive FTO substrate, a sensitizer (i.e. dye; e.g. N719, N3 or organic dyes by monolayer adsorption an electrolyte (e.g. I3_/I_ and Co2+/Co3+ redox couples) injected between the sensitizer and counter electrode, and a counter electrode (e.g. Pt and carbon materials) deposited on another conductive FTO substrate.
Illumination by visible light irradiation on the photoanode causes photoexcitation of electrons occurs from the HOMO (highest occupied molecular orbital) to the LUMO (lowest unoccupied molecular orbital) of the dye followed by injection of electrons from the LUMO level to the conduction band (CB) of the semiconductor leaving the dye in an oxidized state. The oxidized dye is restored to its original state by electron transfer from the electrolyte, and this step is known as the dye regeneration process. Regeneration of the dye by the iodide intercepts the recapture of the injected electron in the CB by the oxidized dye. The triiodide ions (I3-) formed by the oxidation of iodide diffuse through the counter electrode usually composed of finely divided Pt. The regenerative cycle is completed by the conversion of I3- to I- ions. The counter electrode returns charge from the excitation external circuit back to the cycling circuit in the cell.
Titaniumdioxide (TiO2), as one of the most important semiconductors, has been extensively studied due to its high catalytic activity, long-term stability and considerable versatility in various fields such as photo catalysis, photovoltaic cells, sensors, lithium ion battery materials, pigments, sunscreens.
Owing to the above concepts and the importance of Dye sensitized solar cells I have planned to work on “Synthesis and Characterisation of Hydrothermally prepared Titatiumdioxide Nanoparticles to Improve the Stability and Efficiency of Dye Sensitized Solar Cell”
Titaniumdioxide will be prepared by hydrothermal method. For the prepared TiO2 nanoparticles X - ray diffraction is performed to determine the crystallographic structure and phase purity .The specific surface area and pore size distributions of the nanostructures were calculated from Brunauer–Emmett–Teller (BET) and Barrett–Joyner–Halenda (BJH) approach respectively. The morphological images of NP were identified with Field Emission Scanning Electron Microscopy (FESEM) and High Resolution Transmission Electron Microscopy (HRTEM). The elemental composition of the NP is analyzed with Energy Dispersive Spectroscopy (EDS). Finally, the NP were prepared as a photoanode, which is applied to DSSC.
The photoelectric conversion efficiency is calculated by knowing short circuit current, open circuit voltage, fill factor, power input. The fill factor (FF) is the ratio between the maximum output power density available and the maximum power combining short-circuit and open-circuit situations. By improving the efficiency of DSSC it can contribute to the global needs.

67. Tunneling Field Effect Transistor: Challenges and Solutions: Dip Joti Paul*, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

Effect of transistor’s length scaling

- Speed of transistor has increased
- Transistor density or roughly function density of IC has increased
- Price per transistor or roughly cost paid to one function has decreased
- Tremendous increase of IC power density

68. Radioastronomy and Applied Radio Frequency, Complex Systems Modelling, Climate Research and Renewable Energy: Dr. Michel Roddy Lollchund*, University of Mauritius, Reduit, Mauritius



69. Bioactive ceramic powder prepared using a new sol-gel process: Dr. Xuan Vuong Bui*, Sai Gon University, Ho Chi Minh City, Vietnam

- Bioglasses or their derivation can be used to bone replacement.
- When implanted, they reacts with the surrounding physiological fluid, causing the formation of a hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$ (HA) layer at the material surface. The HA layer has a similar composition to the mineral phase of bone, which allows for strong interaction and integration with bone.
- This study is to synthezise the bioceramic with 45% SiO_2 - 24.5% CaO - 24.5% Na_2O – 6% P_2O_5 (wt%), wich is similar to the bioglass 45S discovered by Larry Hench 1970.

70. Conversion of Eppawala Apatite into Non-Toxic Hydroxyapatite Nanoparticles: Mallika Gedara Gayan Sasanka Nirodha Thilakatrathna*, University of Peradeniya, Peradeniya, Sri Lanka

Apatite deposit located at Eppawala is the largest economically important naturally occurring apatite deposit in Sri Lanka. A very high economic value can be added to Eppawala apatite deposit by synthesizing medical grade hydroxyapatite (HA) nanoparticles as those HA nanoparticles are marketed at high cost. Therefore, our attempt in this study is to synthesize non-toxic HA nanoparticles from EPAP using an effective simple technique.
The HA nano particles were synthesized through a process of calcination.
That resultant HA nanoparticles were revealed in XRD and FTIR results. Removal of impurities of F^- and Cl^- was confirmed using EDX spectra. MTT assay confirmed that the synthesized HA nanoparticles are nontoxic. Therefore, there is a high potential to use this synthesized HA product in biomedical applications, which is a long awaited substantial value-addition to EPAP

71. Nanoemulsion based-novel drug delivery system for Controlled release of Diclofenac sodium with synthesized glycolipid as permeation enhancer: Pubudu Premarathne*, University of Peradeniya, Peradeniya, Sri Lanka

The effect of the glycolipid, hexadecyl-β-D-glucopyranoside, incorporated in Nanoemulsions (NE) towards the enhancement of skin absorption and skin permeation of Diclofenac sodium (DS) was evaluated. A Franz diffusion cell with a piece of pig's ear epidermis indicated that the optimized NE formulation with glycolipid (0.05 wt%) exhibited significantly higher permeability than the conventional formulations.
A glycolipid, hexadecyl-β-D-glucopyranoside, was synthesized and characterized by using Nuclear Magnetic Resonance Spectroscopy (NMR) and Fourier Transform Infrared Spectroscopy (FTIR) and its ability to stabilize microemulsions loaded with bioactive compounds was investigated. Both acetylated and deacetylated compounds were found to exhibit thermotropic and lyotropic liquid crystal behavior.
The releasing profiles of DS from NE formulations exhibited first order release kinetics resembling a diffusion controlled release model for the first 8 h. Incorporating hexadecyl-β-D-glucopyranoside in NE formulations shows significant potential as a delivery vehicle in the cosmetics and pharmaceutical industry.

72. Research on Nanoscale Devices: Sumaiya Wahid*, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

Our research aims at exploring the existing nanoscale technologies and analyze devices compatible with current trends. Being interested in both the top-down and bottom-up approaches of nanotechnology, we work towards the goal of proposing structures, methods and devices that may be the future of nanotechnology. Our work also includes the analytical/empirical/semi-empirical/compact modeling techniques of different devices with a view to understanding the device physics along with achieving computational efficiency. In order to carry out the large-scale simulation works, we are equipped with standard High- Performance-Computing (HPC) facility to accommodate 1D/2D/3D device simulators, widely used open-source molecular dynamics simulation softwares as well as some commercial softwares through collaboration.

73. Ab-initio Study of the Electronic Properties of Group IV Monochalcogenides Based Hetero-bilayer: Towsif Taher*, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

- 2D atomically thin materials are of considerable interest owing to their intriguing properties promising for a wide range of applications.
- Studies show that no single 2D material possesses perfect properties for the practical applications.
- Modulation of electronic structures and properties is always an open question for the studies of 2D nano-materials.
- Among various modulation methods, constructing Vander Waals (vdW) hetero-bilayer is intensely carried out.

74. Charge career dynamics of PbS in PbS/ CdS quantum dot sensitized solar cell: Electrochemical impedance spectroscopic analysis: Manjceevan Arumukham*, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka

In PbS/CdS quantum dot sensitized solar cell (QDSCs), the PbS q-dots were synthesised with varying the cationic, and anionic precursor solutions by SILAR method. After deposition of a PbS q-dots layer, three cycles of CdS and three cycle of ZnS were deposited by SILAR method on TiO_2 mesoporous layer using 0.05M cationic and 0.05M anionic (S^{2-}) precursor solutions. Likewise various concentrations of precursor solutions used to deposit PbS q-dots. PbS q-dot prepared with 0.03 M lead ion, 0.03 M sulfide ion mixed 3-mercaptoproponic acid showed the highest efficiency of 5.87%. Deposition of PbS q-dots with the low concentration of precursor solution minimized the charge recombination greatly while PbS exhibits high transport resistance. Enrichment of quantum dot deposition with higher concentration of solution results in higher absorbance of light while charge recombination is enhanced and charge transport decreased.

75. Designing high Efficiency CdS/CdTe Based Solar Cell: Ajanta Saha*, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

By the end of 2016, cumulative photovoltaic capacity reached about 302 gigawatts (GW) which is estimated to be sufficient to supply between 1.3% and 1.8% of global electricity demand. Global annual Photovoltaic (PV) power production is expected to reach 500 GW by 2020 making this one the fastest growing markets. As a result, in addition to classical monocrystalline and multicrystalline solar cells novel techniques such as nanocrystalline, metamorphic multijunction, organic processing, thin film and others will pay an important role in the future development of a more and more innovative material and efficient solar cell in low cost.

INUP Indian Nanoelectronics Users Program

Indian Nanoelectronics User Program (INUP) is a joint program run by CeNSE, IISc and IIT Bombay to accelerate research and development activities in the area of nanoelectronics in India. The program, funded by the Ministry of Electronics and Information Technology (MeitY), Government of India (GoI), was launched in 2008 and is now in its second five-year phase.

The program provides hands-on-training to qualified and motivated scientists and engineers from around the country in nanotechnology and subsequently, allows them to carry out their research projects at CeNSE. Easy access to the state of the art equipment and technical expertise of scientists and engineers resident at the Centre makes it possible for aspirants, even from the remote corners of India, to be engaged in cutting edge R&D. INUP has expanded its footprint across India with a network of over 700 educational institutes.

INUP has grown rapidly over the years and now routinely conducts the training workshops throughout the year. At any given time, more than fifty INUP projects are active at CeNSE. Since the launch of the program, more than 6000 scientists from around the country have been trained and more than 600 research projects have been carried out. Based on the research work done under this program, more than 300 Ph.D. scholars, registered in universities across India, have graduated. Users under this program have authored more than 400 publications and more impressively, have applied for more than a dozen patent applications. The unprecedented outreach of the program and its success has been consistently recognized by the government. INUP was a featured program at the “National Good Governance Day” in 2014.

Levels of training provided under INUP:

1. **Familiarization Workshop**
2. **Hands-on Training Workshop**
3. **Execution of Research Projects**

Special Training for Scientists from Neighboring Countries

Over the past few years, India’s role in promoting and assisting development in neighbouring countries has increased substantially. Encouraged by the success of INUP, CeNSE has now embarked on providing INUP-type training to scientists from neighboring countries. The program is supported by the Ministry of External Affairs (MEA), GoI. First of such workshops was conducted on 3rd February 2016, which was attended by 26 scientists from Sri Lanka, Bangladesh, Myanmar and Maldives. The initiative has generated interested from many more countries seeking opportunities to participate in similar programs and access to nanofabrication facilities available at CeNSE. MEA is eager to expand the program, enabling India to become an international hub and destination for nanotechnology R&D.

I-STEM

Linking Researchers and Resources

Indian Science Technology and Engineering facilities Map

"The What and the Why":

It has always been the basic tenet of the Government of India, in generously funding R&D efforts at academic institutions over the years, that facilities established through such support be made available to those needing them and qualified to make use of them for their own research work. However, this was never easy or straightforward for, among other reasons, there was no ready source of information of what facility was available and where. Thanks to the Web, it is much easier today to have a national and regional "inventory of resources", so as to match users with the resources they need, and to do all this in an efficient and transparent manner. This can lead to a leap in R&D productivity and greatly enhance the effectiveness of public investment. This is the motivation behind I-STEM.

It is gratifying that the genesis of I-STEM is the very successful Indian Nanoelectronics Users Program (INUP), supported strongly by the Ministry of Electronics and Information Technology (MeitY), GoI. Now in its tenth year, INUP has provided access to the state-of-the-art facilities at CeNSE to academic researchers from all corners of the country, all expenses paid, so that they could receive hands-on training and carry out sophisticated R&D projects at the Centre. Having benefited from an "open" publicly-funded national resource, INUP participants readily volunteered with information on public-funded facilities in their respective institutions, providing the initial, unofficial database that has now led to the I-STEM national portal.

The How:

The I-STEM Web Portal is the gateway through which users can locate the specific facility (ties) they need for their R&D work and identify the one that is either located closest to them or available to them the soonest. Through a recent directive of the GoI, institutions that have procured and installed R&D facilities with funding from the agencies of the GoI are now (will be) required to list them on the I-STEM Portal (which will be regularly updated and can be accessed via a Mobile App). Either through the I-STEM Portal or the web site of the organization which is the custodian of the desired facility, a user can make a reservation for using it, as per a mutually convenient schedule. To enable the running and maintenance of the resources, the organization may prescribe a user fee, which depends on whether the user is from the academia (and whether s/he has a research grant), a public institution, or from industry. A panel of Experts will be formed over time to help users (via the Web) to make the most informed use of resources made available through I-STEM.

For more details, please visit www.i-stem.ac.in or download the app (i-stem) from google play store.

Centre for Nano Science and Engineering (CeNSE),

Indian Institute of Science, Bengaluru, Karnataka, India

http://www.nano.iisc.ernet.in

CeNSE facilitates **external academic researchers** in the utilization of facilities established at IISc Bengaluru under its **outreach program "INUP"**. It is the interface between the Centre for Excellence in Nanoelectronics (CEN) and researchers from around the India, as well as abroad, enabling them to access state-of-the-art laboratories and the expertise available.

Indian perspective

(Funded by Ministry of Communication and Information Technology, Govt. of India)

About INUP

- INUP Phase I: Launched in August, 2008 and completed its five successful years of operation on 31st Jan 2014.
- INUP Phase II has begun on 1st Mar 2014.
- Conceived and funded under "**Microelectronics and Nanotechnology Development Program**" of the Department of Electronics and Information Technology (**DeitY**), Ministry of Communications and Information Technology (MCIT), Govt. of India.
- Aims to make available the national facilities equipped with state-of-the-art device fabrication and measurement laboratories to researchers from around the country, who lack access to even modest capabilities of the kind.

The Three Levels of INUP

Level 1: Familiarization Workshop involving lectures and tutorials, conducted for about 100 participants at a time;

Level 2: Hands-on Training in device fabrication, measurement, and simulation, held for about twenty five people at a time, selected from among those previously "familiarized";

Level 3: Execution of Research Projects by researchers so trained.

Foreign Perspective

(Funded by Ministry of External Affairs, Govt. of India)

Familiarization Workshop involving lectures and tutorials, conducted for about 30 participants at a time; followed by Hands-on Training in device fabrication, measurement, and simulation,"

First workshop of it's kind was organized on January 17 –Feb 3, 2016 with 26 Participants from different countries:

Sri Lanka **Bangladesh** **Myanmar** **Maldives**

Uniqueness of INUP

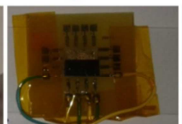
Though the sharing of expensive nanofabrication facilities is the norm around the world, DeitY recognised the different needs of Indian academic researchers. INUP therefore is tailored as a comprehensive training program, leading to the execution of sophisticated research projects at the CEN facilities, with all expenses met by INUP, obviating the need for and delays in obtaining research grants. Such grants are often not available to researchers from small and remote Institutions. It is the perceptiveness of **DeitY** that has made INUP so well received and successful. The "hands-on" aspect of INUP is designed to impart skills, wherein researchers spend many hours in state-of-the-art clean rooms, making devices and getting a "feel" for the processes and technologies involved. INUP is thus very much a pathway to meeting the needs of "Make in India".

An Unexpected Bonus

A collateral benefit – a bonus – of INUP has been the participation of college teachers in Workshops and research projects. Many of them have remarked that, as a result of participating in the Workshops, they can now teach in the classroom better and more confidently – because they have, for the first time, handled a silicon wafer or seen the insides of a an actual VLSI circuit. Thanks to INUP, thousands of students from around the country will learn and know semiconductor technology better.

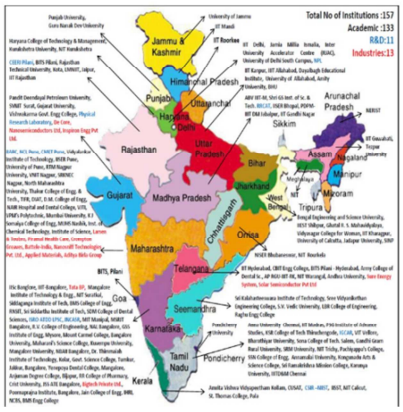
A Sample of Research Projects done under INUP

ZnO-based MSM Photodetectors



Micro-Heater

Osmotic Pressure Sensor



2200 researchers have been trained in INUP Phase I&II, Generating 110 Publications & 13 Patents (to date).

Group Photo of the Participants from India-Neighbouring Countries

Participants undergoing training in the Cleanroom

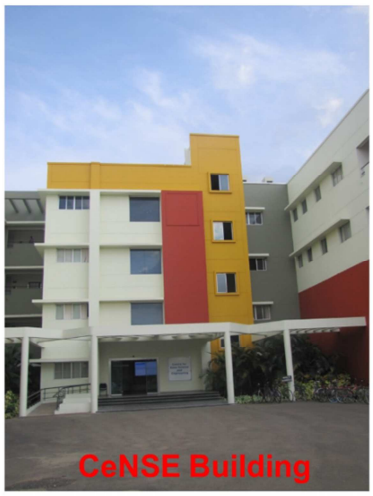
Participants with their posters

Centre for Nano Science and Engineering (CeNSE),

Indian Institute of Science, Bengaluru, Karnataka, India

http://www.censews.iisc.ernet.in

info@cense.iisc.ernet.in



About CeNSE

Started fully functioning in 2011

21000 sq. ft. National Fabrication & Characterization Facilities

MTech, PhD and Summer Internship programs

15 Faculty Members (of which 5 are Emeritus)

150 PhD & 40 MTech Students / 130 Dedicated Staffs

Outreach Programs for Indian and Foreign Academics

Substantial discount on facility usage to Indian and Foreign Academics

What We Do

Research	• Research on fundamental aspects of science and technology
Development	• Enable the conversion of technology to products with impact
Education	• High Impact manpower for the country

Create social impact!

Additional focus on addressing problems of local relevance

Products – Using CeNSE technologies

Pressure Sensor (400 bar)

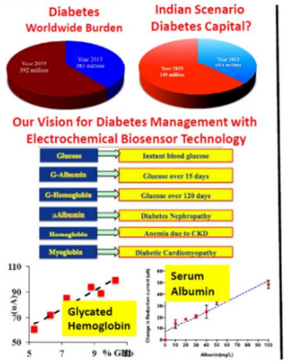
Envirobat Gas Sensing Monitoring System

ICP Intracranial Pressure Sensor

Electrolithography

PM Shri Modi, being presented with a memento in which "OM" was scribed by electrolithography (Nanometer Scale) on February 18, 2015

Handheld Device for Diabetes Management developed through in house R&D



Translating Ph.D. Research to Product through the Incubation of Startup

Path Shodh HEALTHCARE *Inventing lifelines...*

- 7 Indian Patents, 1 US Patent, + 5 International patents to be filed
- Sept 2015: Start up incubated at SID, IISc
- Aug 2016: Expected product launch

The CVD System developed by scientists at CeNSE, in collaboration with KAS Technologies, Bengaluru

The CVD system, developed for commercialization, *was launched in March ,2016 at the Bangalore Nano Conclave"*

Cleanroom Facility~75 Tools

Characterization Facility~35 Tools

About CeNSE

The Centre for Nano Science and Engineering (CeNSE) was established in 2010. CeNSE focuses on interdisciplinary research and education in the broad area of nanoscale science and technology covering topics such as Nanoelectronics, devices, materials, micro- and Nano-electromechanical systems, bio- and Nano-photonics, bio-electronics, interfaces and integrated small-scale systems. In addition to the research programmes of the core faculty, the Centre runs an interdisciplinary research programme involving more than 40 faculty members from various departments of basic science and engineering at the Indian Institute of Science (IISc). The Centre offers a PhD programme of its own and an interdisciplinary PhD programme in allied areas, and has close interactions with industry. Starting from 2014, CeNSE has initiated an M.Tech degree program in Nano Science and Engineering. A state–of-the-art nanofabrication facility with a clean room spanning 1400 square meters is located at the Centre. In addition, there are several characterization labs that cater to material, electronic, mechanical, chemical and optical characterization. The Indian Nanoelectronics Users Programme, INUP, is a unique initiative of the Ministry of Electronics and Information Technology (MeitY), GoI, was launched in 2008 to accelerate research and development in Nanoelectronics. To this end, INUP provides training to aspiring researchers in Nanoelectronics, as well as, access to the advanced (national) facilities at CeNSE, where work on selected, meritorious research projects may be conducted with help and guidance of faculty members and technical staff at CeNSE. To date, hundreds of researchers from over 150 academic institutions from around the country have participated in INUP training workshops. Many of them have carried out research projects under the INUP, leading to research theses, publications, and patents.

To know more about CeNSE, please visit:

http://www.cense.iisc.ac.in/