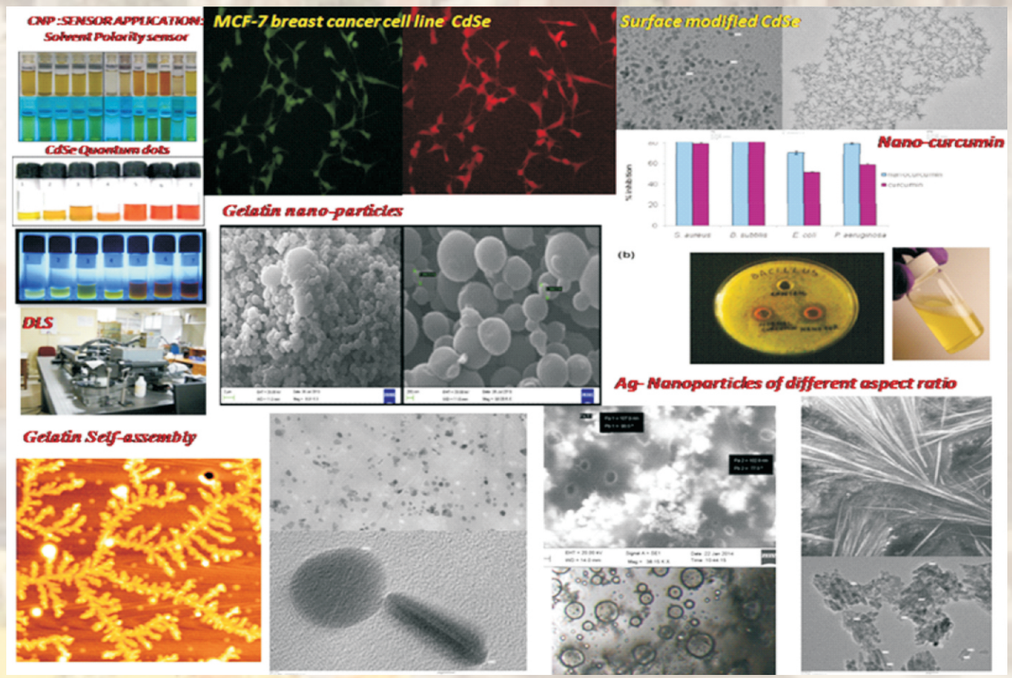
Special Centre for Nanoscience, JNU

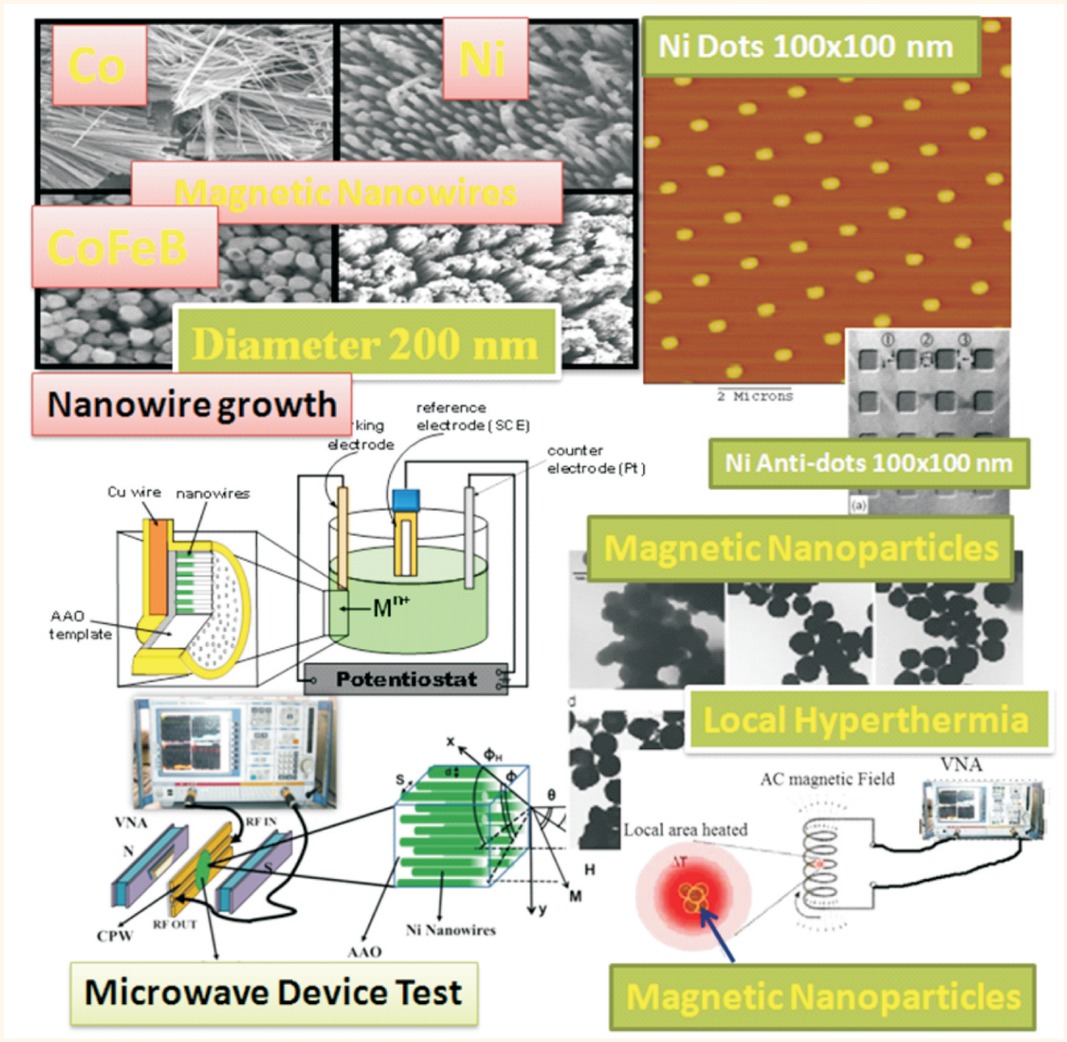
Department Profile 2014-15

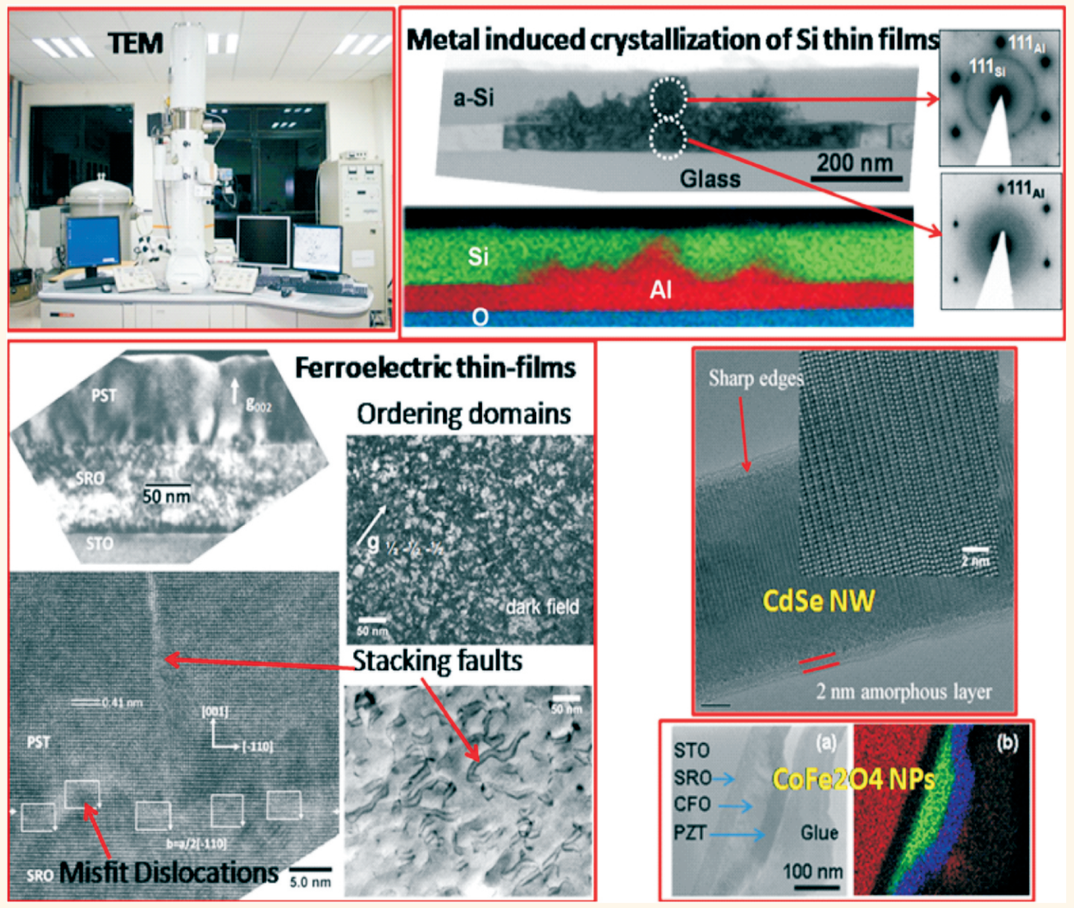
Jawahar Lal Nehru University
New Delhi

Glimpses...



Glimpses...





Special Centre for Nanoscience
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CONTENT

Introduction

INTRODUCTION

There are several groups within the School of Physical Sciences, Centre for Biotechnology, School of Environmental Sciences and School of Life Sciences that are actively pursuing research work that touch many aspects of Nanosciences and Nanotechnology. However, the synergy is clearly missing, though collaborations limited to personal levels exist. Since, JNU has the advantage of having the culture of interdisciplinary research ingrained into its ethos; it is natural that a discipline like nanosciences and nanotechnology gets inroad into the academic program before it is too late. In this spirit, an Advisory Committee comprising of six scientists was set up in 2006 (under the Chairmanship of Prof. H. B. Bohidar) to explore the possibility of starting such an activity in JNU. The Advisory Committee Report was submitted to the University where it was categorically recommended that a nanosciences centre be created in JNU immediately.

The essence of nano-sciences is the ability to work at molecular level, atom by atom to create macro-structures with fundamentally new molecular organization. The objective is to exploit their unique properties by gaining control structures and devices at atomic, molecular and supramolecular levels and to learn to efficiently manufacture and use these structures. Nanotechnology is the application of these assemblies in solving real life problems. Thus, with nano-sciences and nanotechnology, one attempts to optimize what we know about science and how we apply this knowledge to solve problems.

The Special Centre for Nanoscience (SCNS) was established in JNU during the year 2010 as a fully supported program of UGC under the XIth Five Year Plan. Special attention is required to be given to human resource development. Implementation of nano-initiative projects would require new generation of workers to be trained in multidisciplinary perspectives. The teaching of concepts of nano-scale must begin and continue to penetrate the education systems at least from the under graduate level. The road-map envisaged includes capacity building in this area by encouraging interdisciplinary teaching and research programs immediately.

SCNS is an upcoming inter-disciplinary research and teaching centre at JNU. The nano-sciences related research topics pursued currently include soft condensed matter, nanoscale interface, bio-sensors, ferromagnetic materials, ferroelectric materials, nano

composites, hybrid nanomaterials to name a few. The Centre has faculty members with background in Physics, Biology and Materials Sciences. This newly formed centre works closely with the School of Physical Sciences.

NEXT FIVE YEAR RESEARCH AGENDA OF SCNS

Research agenda of SCNS involves synthesis, characterization and device development of nanomaterials. These include (i) magnetic nanostructures (nano-wires and nano-particles) and nano-devices (microwave monolithic nano-devices and Magnetic sensors), (ii) Magnetic nano-particles for target specific drug delivery, (iii) semiconductor quantum dots, nanoparticles and nanocomposites for solar cells and biosensors, (iv) multiferroic and ferroelectric nanomaterials for capacitors, UV sensors, wireless actuators, infra-red detectors, micro-electro-mechanical system (MEMS) devices, piezoelectric devices, ferroelectric nonvolatile random access memories (FeRAMs).

The frequency range of 10-100 GHz is particularly interesting because there are a number of possible military and civilian applications. (1) The military has a need to see through fog, clouds and smoke. These obstacles are transparent for particular frequencies in the GHz range. Thus signal processing in this range is significantly importance. (2) This frequency range has civilian uses as well, like, tracking and landing planes in severe weather conditions (dense foggy weather in various parts of the country). (3) Cell phones are now starting to use higher frequencies (in the several GHz range). In order to separate one channel from another it is important to fabricate variety of signal processing devices. The fabricated device will be on-chip, light weight and hand held type use.

Modern disk drives can read or write a bit in every few nano-seconds, this time scale is similar to magnetic damping time of the ferromagnetic metals used in the Giant-Magneto-Resistance (GMR) sensor. In MRAM (magnetic Random Access Memory) it is likely that damping can limit DATA transfer rate. It can be determined by the relaxation time of a magnetic system. Damping of nano-structures can be measured by ferromagnetic resonance (FMR) linewidth using a Network Analyzer. Using a magnetometry set-up (like MOKE) magnetization, coercivity and remanence will be studied.

Currently incurable disorders like brain cancer, Alzheimer's, and Parkinson's diseases reduce quality of life of millions of people worldwide. Successful therapy involves two critical components: (i) the detection of pathologies and (ii) effective drug delivery. Magnetic nanoparticles provide both of these therapy components since they have dual function of acting as contrast agents for magnetic resonance imaging (MRI) as well as carriers for drug delivery.

The device fabrication program will comprise mask designing, device structure deposition (Electro-deposition of magnetic nano-wires, deposition of thin film through shadow-mask), Photo-lithography, etching, etc. using a clean-room facility. Microwave device characterization will be done with a Vector Network Analyzer along with a micro-probe station.

Physical properties of the synthesized nanomaterials like quantum yield of semiconductor quantum dots, dielectric constant and polarization of multiferroic and ferroelectric nanomaterials will be measured. Emphasis is also laid on the nanostructural characterization of the synthesized nanomaterials using electron microscopy and XRD techniques. Phase and structural information obtained using XRD and SEM based techniques will be used for the optimization of material synthesis methods. The unique capabilities of TEM techniques namely, imaging of bulk crystal defects (dislocations, stacking faults and interfaces, secondary phases) with sub NM spatial resolution while simultaneously determining the crystal structure information using diffraction techniques and chemical information using Energy Dispersive X-ray Spectroscopy, will be used to achieve structure-property correlation in nanomaterials.

Efforts will be made towards the application of nanomaterials and thin films for fabrication of bio sensing electrodes using different enzymes, antibodies, antigens and DNA for the clinical diagnosis and environmental sample monitoring using electrochemical and optical techniques. New methods will be developed for monitoring and remediation of heavy metal (lead and chromium etc.) contamination of water and soil samples using nanomaterials.

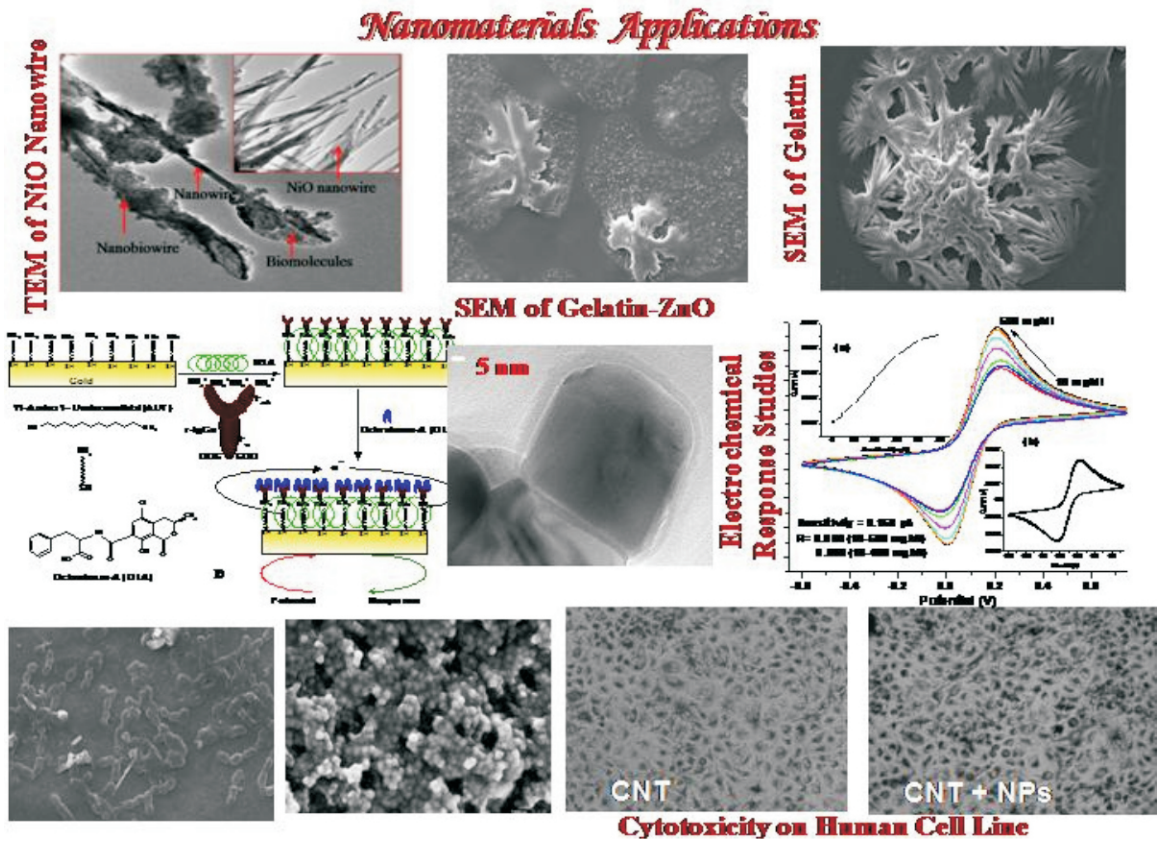
Presently, The Centre has nanomaterial synthesis and nano biosynthesis lab consisting of all basic characterization facilities including FTIR-Raman spectrophotometer, laminar hood, BOD incubator, Dynamic Light Scattering, Zeta Potential Measurement, UV-NIR Spectrophotometer, Viscometry, Tensiometry, Potentiostat-Galvanostat, while others like Cell culture facility, Fluorescence Spectrophotometer, Contact Angle Measurement will be installed soon. A wide range of analytical facilities including Transmission Electron Microscopy, Scanning Electron Microscopy, Confocal Microscope, and other on-line cell imaging facilities are available at the Advanced Instrumentation and Research Facility, which is at the central facility of JNU, and at the School of Physical Sciences.

SCNS introduces a Ph.D. (Nano Sciences) program with effect from the academic year 2014-15.

People.....

1. H. B. Bohidar
2. Satyendra Singh
3. Bijoy Kumar Kuanr
4. Pratima R. Solanki
5. Balaji Birajdar
6. Samer Singh
7. Kamla Rawat
8. Pramod
9. Mamta
10. Girish
11. Ashish

Glimpses....



PROGRAMMES OF STUDY

(A) PROGRAMME OF STUDY

- **Pre-Ph.D./Ph.D. program in Nano Sciences****

Candidates selected are required to take a minimum of five Pre-Ph.D. courses (including Research Courses) in the first two semesters. Satisfactory completion of the Pre-Ph.D. course work is a prerequisite for confirmation to the Ph.D. program.

- **(NET qualified candidates)**

The candidates must have qualified for Junior Research Fellowship through CSIR/UGC or an equivalent National Eligibility test that guarantees a fellowship from the funding agency concerned. Candidates shall have to appear for an interview and their selection will depend on their performance in the interview. Candidates who have appeared in the above mentioned examinations but whose results are awaited may also apply under this category. However, such candidates will only be interviewed upon submission of a valid proof of having qualified for or awarded the JRF certificate at the time of interview. Candidates who have been awarded only the "Lecturership" in the CSIR/UGC examination are not eligible and will not be interviewed.

**** Subject to approval of Academic Council.**

Pre-Ph.D. Course Structure

(B) ELIGIBILITY FOR ADMISSION

- **Pre-Ph.D./Ph.D programme in Nano Sciences**

Candidates must have M.Sc. degree in Physics, Chemistry, Biology, Materials Science, Nanosciences, and Nano-Technology with at least 55% marks or equivalent grade point. Candidates must have had mathematics at least up to 12th standard or equivalent.

ELIGIBILITY FOR ADMISSION

Selected students will have to take up a two semesters Pre-Ph.D. course work (15 credits total). A CGPA of 6.5 is mandatory for subsequent registration to the Ph.D. program.

AVERAGE ANNUAL INTAKE

Centre's annual intake of students depends on the availability of laboratory space with the faculty and is generally five. The selected students will have the option to choose his/her research area depending on the vacancy available and on their merit/aptitude. The annual student intake is likely to increase in coming years.

PRE-Ph.D. COURSE STRUCTURE

1st SEMESTER

Course code	*Name of the course*	*Faculty Coordinator*
NS 611	*Physics and chemistry of Materials*	*(Dr. Satyendra Singh)*
NS 613	*Basic Physics for Nanoscience*	*(Dr. Bijoy K. Kuanr)*
NS 615	*Bio-Nanosciences*	*(Dr. Pratima R. Solanki)*

2nd SEMESTER

Course code	*Name of the course*	*Faculty Coordinator*
NS 612	*Synthesis and Characterization of Nanomaterials*	*(Dr. Balaji Birajdar)*
NS 614	*Properties and Applications of Nanometerials*	*(Dr. Satyendra Singh)*
NS 616	*Recent developments in Nano Science*	*(Dr. Bijoy K Kuanr)*
NS 618	*Research Methodology*	***(Concerned Instructor)***

PRE-Ph.D. COURSE DETAILS

NS 611: Physics and chemistry of Materials

Course Coordinator : Dr. Satyendra Singh **Credits : 3**
(Total Lectures: 40)

Introduction to Nanoscience:

Introduction to Nanoscience and Nanotechnology, Significance of Nanoscale (Surface Area; Quantum Confinement effect), Different types of Nanomaterials. **(3 L)**

Structure of Matter:

Amorphous, crystalline, crystals, polycrystals, symmetry, Unit Cells, Crystal Structures (Bravais Lattices), Crystallographic Directions, Crystallographic Planes, Miller Indices, Bragg's Law, Single Crystal and Powder X-ray Diffraction. **(7 L)**

Chemical Bonding:

Bonding Forces and Energies, Types of bonding: Ionic, Covalent, Metallic and van der Waals, Hydrogen bonding; Hybridisation; Molecular orbital theory for simple molecules such as diatomic molecule etc. **(6 L)**

Imperfections in solids:

Point defects, Impurities in solids, Grain boundaries, Phase boundaries, Screw, Edge and Mixed Dislocations; Generation of defects by quenching, by plastic deformation and by radiation, Interaction between point defects and dislocations. **(6 L)**

Diffusion:

Fick's Law, mechanisms of diffusion; generation of point defects; self-diffusion; the influence of the pressure and pressure gradient; Kirkendall effect; fast diffusion; influence of isotropic state; experimental methods of investigation of diffusion. **(6 L)**

Theory of Solution and related topics:

The theory of solutions, Free energy as a function of composition, Methods for calculation of thermodynamic equilibrium, Electrochemical processes. **(6 L)**

Phase Transformations:

Mechanisms of phase transformation; homogeneous and heterogeneous nucleation; spinodal decomposition; grain growth; precipitation in solid solution; transformation with constant composition; order-disorder transformations; Martensitic transformation. **(6 L)**

Books:

1. Introduction to Solid State Physics -7thedition -C. Kittel, Publisher: Wiley India Pvt. Ltd.
2. Solid State Physics- A.J. Dekker, Publisher: Macmillan India Ltd.
3. Materials Science & Engineering: An Introduction, 7thedition- William D. Callister, Jr, Publisher: Wiley India Pvt. Ltd.
4. Solid State Chemistry and its applications by Anthony R. West, Publisher: John Wiley & Sons.
5. **Fundamentals of Statistical and Thermal Physics by F. Reif.**

NS 613: Basic Physics for Nanoscience

Course Coordinator : Dr. Bijoy K. Kuanr **Credits: 3**
(Total Lectures: 40)

Introduction

Wave-particle duality, Schrödinger equation and expectation values, Uncertainty principle. **(3 L)**

Basics of Quantum mechanics:

Solutions of the one-dimensional **Schrödinger** equation for free particle, particle in a box, particle in a finite well, linear harmonic oscillator. Reflection and transmission by a potential step and by a rectangular barrier. **(5 L)**

Solution of Time independent Schrödinger equation at higher dimensions and more complicated systems:

Particle in a three dimensional box, linear harmonic oscillator and its solution, density of states, free electron theory of metals. The angular momentum problem. The spin half problem and properties of Pauli spin matrices. **(10 L)**

Approximate methods:

Time independent and time dependent perturbation theory for non-degenerate and degenerate energy levels. **(3 L)**

EM Wave Theory:

Introduction to EM Wave Theory, Scalar and Vector potentials, Maxwell equations. **(3L)**

Introduction to Thermodynamics:

The first and second laws of thermodynamics, Thermodynamic functions, heat capacity, enthalpy, entropy. Equilibrium in one phase system, real gases, the reactions between gases, reactions of solid-state phases, Phase rule, Phase diagram. **(3 L)**

Elementary Statistical Mechanics:

Microstates and entropy and its statistical definition, Entropy of mixing, Gibb's free energy, Gibb's paradox, phase space density, Liouville's theorem, The Microcanonical, canonical- and grand canonical- ensemble and their connections, Fluctuations. Classical Statistical systems, Boltzmann statistics and quantum statistical systems, Fermi-Dirac and Bose-Einstein Statistics and their applications. **(8 L)**

Books:

1. Concepts Of Modern Physics 6th Edition - Arthur Beiser, Shobit Mahajan; Publisher: Tata Mcgraw Hill Education Private Limited
2. Quantum Mechanics - Bransden and Joachen, Publisher: Pearson, Prentice Hall
3. Quantum Mechanics : Theory & Applications , – A. Ghatak, Publisher: Kluwer Academic Publisher
4. Principles of Quantum Mechanics 2nd ed. - R. Shankar, Publisher: Springer Science
5. Thermodynamics by Zymansky, Publisher; McGraw-Hill Book Company Inc.
6. Statistical Physics by K. Huang, Publisher; John Wiley & Sons
7. Statistical Mechanics-Landau & Lifshitz, Publisher; Elsevier

NS 615 : Bio-Nanosciences

Course Coordinator: Dr. Pratima R. Solanki **Credits: 3**

(Total Lectures: 40)

Molecular Biology: Structure and function of biomolecules/molecules of life (water, protein, carbohydrate, nucleic acid, and lipids); central dogma of molecular biology; synthesis of protein and nucleic acids; forces governing molecular recognition and interaction. **(8 L)**

Cell Biology: Cell and its types (Prokaryote, eukaryote); structure and functional aspects of plasma membrane, cytoskeleton and organelles; structure and general features of fungi, bacteria and viruses; cell division and growth. **(8 L)**

Natural and engineered bionanocomposites: Natural nanocomposite systems (*e.g.,*abalone shell, spider silk, spine of sea urchin); biomimetic nanocomposite materials; use of synthetic nanocomposites for bone, teeth replacement etc. **(8 L)**

Interactions of cells with nanomaterials: Dependence of interaction on physiochemical properties of nanomaterials, immune system, biocompatibility, surface functionalization as a means to enhance biocompatibility, nanomaterials distribution (drug release kinetics and transport mechanism) in biological system, toxicity evaluation and regulatory issues. **(8 L)**

Environment aspect of nanomaterials: Prevalence and distribution of natural and engineered nanomaterials; Safety concerns and potential hazards; Environmental impact of engineered nanomaterial; Fate of nanomaterials in organisms; short-term and long term-effects of nanomaterials on biological systems. **(8 L)**

Books:

1. Molecular Cell Biology 6th ed.; H. Lodish, A. Berk, S. L. Zipursky, M. P. Scott, J. Darnell, W. H Freeman & Company, 2008.
2. Lehninger Principles of Biochemistry 5th ed.; David L Nelson, Michael M Cox; W.H. Freeman and Company, 2008.
3. Bionanotechnology; D. S. Goodsell, John Wiley & Sons, 2004.
4. Nanobiotechnology: 1 Concepts, applications & perspectives by Christof M. Niemeyer et.al
5. Nanobiotechnology I &II: Edited by Chad A. Mirkin and Christof M. Niemeyer
6. Nanocomposite Science and Technology. Edited by P.M. Ajayan, L.S. Schadler, P.V. Braun
7. Safety of nanoparticles: Thomas J. Webster

NS 612: Synthesis and Characterization of Nanomaterials

Course Coordinator: Dr. Balaji Birajdar **Credits: 3**
(Total Lectures: 40)

Physical Methods:

Inert gas condensation, Arc discharge, RF-plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and other variants, Electrodeposition. **(7 L)**

Chemical Methods:

Metal nanocrystals by reduction, Solvothermal synthesis, Photochemical synthesis, Electrochemical synthesis, Nanocrystals of semiconductors and other materials by arrested precipitation, Thermolysis routes, Sonochemicalroutes,, Liquid-liquid interface, Hybrid methods, Solvated metal atom dispersion, Post-synthetic size-selective processing. Sol- gel synthesis, Micelles and microemulsions, Cluster compounds. **(7 L)**

Biological Methods of Synthesis:
Microbial nanoparticles synthesis; Magnetosomes; Recombinant DNA technology; Genetic approaches to programmed assembly; Virus directed synthesis of nanostructured materials; Virus like particles; Plants as a source of nanoparticles; Biomolecules (protein, DNA)based nanostructures. **(7 L)**

Characterization using Scattering and Imaging techniques:
XRD. Dynamic light scattering, Optical microscope (Phase contrast, DIC, etc.). SEM based techniques (Secondary electron imaging, backscattered electron imaging. Electron backscattered diffraction (EBSD)). TEM based techniques (diffraction contrast imaging, Electron diffraction, High resolution imaging, Z-contrast imaging). Scanning probe microscopies (AFM, PFM, STM). **(9 L)**

Characterization using Spectroscopic techniques:
Band gap measurements. UV-VIS-IR, FTIR, Raman, XPS. Auger spectroscopy. EDXS, WDXS, EELS, STM. **(3 L)**

Electrical measurement techniques:
Resistivity, Polarization, Dielectric constant, Electrochemical techniques. **(3 L)**

Magnetic measurement techniques:
Magneto-Resistance, VSM, SQUID, MOKE, Ferromagnetic Resonance, Light Scattering etc **(4 L)**

Books:

1. Introduction to Nanoscience, Lindsay S. M., Oxford University Press, 2010
2. Novel Nanocrystalline Alloys and Magnetic Nanomaterials, Brian Cantor, CRC Press, 2004
3. Chemistry of nanomaterials : Synthesis, properties and applications, CNR Rao, A Mueller, A K Cheetham, Wiley, 2004
4. X-Ray Diffraction by Polycrystalline Materials, R. Guinebreitiere, ISTE, 2007
5. Scanning Probe Microscopy in Nanoscience and Nanotechnolog, B. Bhushan (editor), Springer, 2010
6. Scanning Microscopy for Nanotechnology, W. Zhou, Z. L. Wang (editors), Springer, 2006
7. Electron Microscopy and Analysis-Goodhew P J, Humphreys J, Beanland R, Taylor and Francis, 2000
8. Transmission Electron Microscopy: A Textbook for Materials Science (4-Vol Set)-David B. Williams and C. Barry Carter, Springer, 2009
9. Dynamic Light Scattering: With Applications to Chemistry, Biology, and Physics, Bruce J. Berne, Robert Pecora, Courier Dover Publications, 2000

NS 614: Properties and Applications of Nanomaterials

Course Coordinator: Dr. Satyendra Singh **Credits: 3**
(Total Lectures: 40)

Electronic Properties: Classification of materials: Metal, Semiconductor, Insulator, Band structures, Brillouin zones, Mobility, Resistivity, Relaxation time, Recombination centers, Hall effects. **(4 L)**

Confinement and transport in nanostructure:
Current, reservoirs, and electron channels, conductance formula for nanostructures, quantized conductance. Local density of states, Ballistic transport, Coulomb blockade, Diffusive transport, Fock space. Dielectric Properties Polarization, ferroelectric behaviour. **(4 L)**

Optical Properties: Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. **(4 L)**

Thermal Properties: Concept of phonon, Thermal conductivity, Specific heat, Exothermic & endothermic processes. **(3L)**

Mechanical Properties: Young's modulus, Bulk Modulus, Modulus of rigidity. Tensile Testing and Tensile Strength, Yield Strength, Breaking Strength, Plastic Deformation, Statistical Analysis of Failure Data, True Stress and Strain Bend Testing – Flexural Strength and Modulus, Brinnell Testing – Hardness, Impact Testing – Toughness, Resilience, Scratch Test. **(5 L)**

Magnetic Properties: Fundamentals of magnetism, Different kind of magnetism in nature: Diamagnetism, Paramagnetism, Ferromagnetism, Ferrimagnetism, Anti-ferromagnetism, Super-paramagnetism. RKKY Interactions.Giant-Magneto-Resistance (GMR) and other important properties relating to nanomagnetism **(5 L)**

Applications of nanomaterials in physical sciences: Thin-film technologies, semiconductor TFTs, MEMS, Actuators, Sensors, Solar cells, Coatings. **(3 L)**

Application of Nanomaterials in biology: Biosensors; types of biosensor; application of biosensor in environmental assessment; biosensors in clinic (diagnosis, imaging and therapy) bioelectronic devices; targeted and non-targeted delivery of cargo (*e.g.,* DNA, RNA, protein, drug) in therapeutic applications, immune enhancement and agricultural applications; Nano structures as novel antibiotics. **(8 L)**

Nano Technology/Nanolithography: Basics of lithography, optical, micro, ion beam lithography, lithographic tools, nanoimprint lithography – polymeric nanofiber templates – focused ion beam doping wet chemical etching – stencil lithography and sacrificial etching – large scale integration – future challenges –applications. **(6 L)**

Books:

1. Novel Nanocrystalline Alloys and Magnetic Nanomaterials- Brian Cantor, IOP Publishing Ltd. 2005.
2. Introduction to Nanoscience and Nanotechnology: A Workbook - Masaru Kenneth Kuno, 2004.
3. Introduction to Nanotechnology - Charles P. Poole Jr. and Franks. J. Qwens, John Wiley & Sons, Inc, 2003.
4. Materials Science & Engineering: An Introduction, 7thedition- William D. Callister, Jr, Publisher: Wiley India Pvt. Ltd.
5. Nanomaterials and Nanosystems for Biomedical Applications: Edited by M. Reza Mozafari.
6. Nanoparticles for Drug Delivery, by Meredith L. Hans and Anthony M. Lowman.

NS 616: Recent developments in Nano Sciences

Course Coordinator: Dr. Bijoy K. Kuanr **Credits: 3**

(Total Lectures: 40)

Recent developments in Magnetic Nanostructures **(10 L)**

Magneto-resistance and hard disk drive read head, Magnetic Random Access Memory (MRAM), Newstorage media with Barium Hexaferrites, Microwave-Assisted Magnetic Recording (MAMR), Monolithic Microwave Integrated Circuits (**MMICs**) Fabrication processes for microstrip line and co-planar wave guide geometry. In-corporation of magnetic nanostructures like ultra-thin film, nano-wires and nano-particles into magnetic-MMICs. Characterization & theory of magnetically tunable Monolithic microwave reciprocal and non-reciprocal devices.

Recent wet chemistry methods for the synthesis of nano-materials. **(5 L)**

Recent developments in Nano ferroelectrics & Multiferroics: preparation methods, microstructure, physical properties and applications. **(5 L)**

Recent developments in nanobiosensors (*e.g.,*Biochip, microfluidic, lab on-chip). Synthesis, fabrication, detection using different techniques including electrochemical, optical etc. **(5 L)**

Recent developments in nanomedicine (*e.g.,*imaging, diagnostics, therapeutics, tissue engineering). Use different nanomaterials as drug carriers, imaging agents, *in vivo* and *in vitro* applications, biopolymers for generating artificial tissues. **(5 L)**

Recent developments in environmental monitoring and remediation. Use of nanomaterials for monitoring of water, soil and air; nanomaterials for water purification and soil remediation. **(5 L)**

Current challenges and perspective. **(2L)**

Recent developments in the electron microscopy of nanomaterials. **(3 L)**

Books/Articles:

- http://www.scientificamerican.com/article.cfm?id=spintronics
- Twenty years of Magnetic Nanostructures studies; Acta Physicae Super? cierum Vol. XII (2012)
- http://www.nanohub.org/
- http://www.nanowerk.com/
- http://pubs.acs.org/journal/nalefd
- http://www.nature.com/nnano
- http://www3.interscience.wiley.com/journal/107640323/home

NS 618: Research Methodology

Course Coordinator: Concerned Instructor **Credits: 3**

(Total Lectures: 40)

- Hands on training: Synthesis of Nanomaterials
- Demonstration of some nanomaterials characterization techniques like XRD, SEM, TEM, FTIR, Raman Scattering, UV, Electrochemical, AFM etc.
- Term papers and literature review
- Research Article writing
- Seminar presentations

FACULTY OF THE CENTRE

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Web Address : http://www.jnu.ac.in

Professor H.B. Bohidar
Professor and Chairperson

Research Interests: Soft Matter, Nanosciences, Biophysics
Number of students awarded Ph. D.: 13
Number of Ph. D. students currently enrolled: 7

Qualifications

Ph. D. (Indian Institute of Technology, Delhi, 1982)

Areas of Interest/Specialization

Soft Matter, Nanosciences, Biophysics

Experience

Post Doc: 1983-1985 - University of Grenoble, France
1985-1988 - Institute of Physics, Oslo, Norway
1998-till date - Professor, JNU, New Delhi
Visiting Professor : 1999-2000: Purdue University, USA
2006 : University of New South Wales, Australia

International Collaboration/Consultancy

Prof. P. Dubin-University of Massachusetts, USA
Prof. M. Dotty-University of Delaware, USA

Best Peer Reviewed Publications (upto 5)

1. Ergodicity breaking and aging dynamics in Laponite- Montmorillonite mixed clay dispersions, Ravikumar Pujala and H.B. Bohidar, Soft matter (2012), 8, 6120-6127.
2. DNA-Gelatin Complex Coacervation, UCST and First-Order Phase Transition of Coacervate to Anisotropic Iongel in 1-Methyl-3-Octyl Imidazolium Chloride Ionic Liquid Solutions, Kamla Rawat and H. B. Bohidar, J. Phys. Chem. B, 116, (2012), 14805-14816.
3. Condensation, complex coacervation and over charging during DNA-gelatin interaction in aqueous medium, Najmul Arfin and H. B. Bohidar, J. Phys. Chem. B., 116 (2012), 13192-131-99.

4. Slow Dynamics, Hydration and Heterogeneity in Laponite nanoclay Dispersions, Ravikumar Pujala and H.B. Bohidar, Soft matter (2013) 9, 2003-2010.
5. Negative differential resistance in nanoclay films offers pressure sensing characteristics, Nisha Pawar, H. B. Bohidar, A. Sharma and S. Ghosh, Appl. Phys. Lett. (2013), 102, 103109.

Recent Peer Reviewed Journals/Books (upto 3)

Recent Books :

1. Polymer Gels: Fundamentals and Applications, (American Chemical Society, Washington DC, 2002)
2. Fundamentals of Polymer Physics and Molecular Biophysics (Cambridge University Press, 2014, UK, in print)
3. Polyelectrolytes: Thermodynamics and Rheology, Visakh P. M., Oguz Bayraktar, Guillermo Alfredo Picó (Springer,Verlag 2014, in press)

Patents (if any)

Un-functionalized Carbon Nanoparticles having Fluorescence Characteristics, Method of Preparation Thereof, and their Use as Bioimaging and Solvent Sensing Agents". Indian Patent appl. No. 2184/DEL/2010. International: PCT/WO 2012/035545A2.

Research projects sponsored by

1. Gelation kinetics and thermo-mechanical characteristics of physically crosslinked ionogels: Department of Science and Technology, (2013-16): Rs. 50 lakhs.
2. Structure of DNA-protein complexes in ionic liquid environment: IUC-DAEF, (2012-15): Rs. 10 lakhs.

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Email : satyendra@mail.jnu.ac.in
Web Address : http://www.jnu.ac.in

Dr. Satyendra Singh
Associate Professor

Qualifications

Indian Institute of Science, 2009 Bangalore, India. M.Tech. (Materials Technology, 2004), Institute of Technology, Banaras Hindu University (Now IIT-BHU), Varanasi, India.

Areas of Interest/Specialization

Functional Nanomaterials (Synthesis and characterization), device applications.

Experience

Associate Professor, SCNS, JNU, New Delhi (19.12.2013 – till date). Assistant Professor/Lecturer, Applied Science Department, PEC University of Technology Chandigarh (03.08.2001 - 18.12.2013).

Awards & Honours

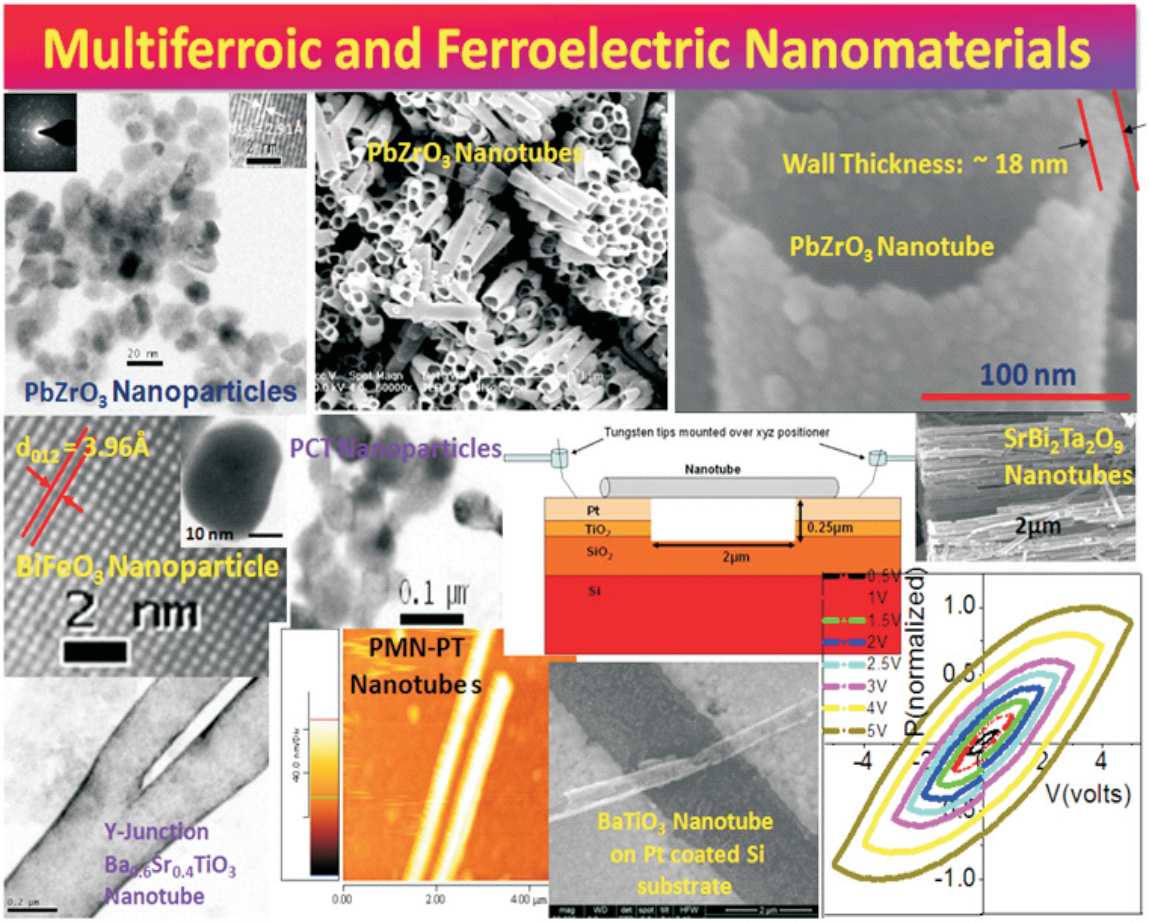
Qualified National Eligibility Test (NET) and GATE in 2001.

Best Peer Reviewed Publications (upto 5)

1. Satyendra Singh and S.B. Krupanidhi, "Synthesis and structural characterization of Ba0.6Sr0.4TiO3 nanotubes", Physics Letters A, 367, 356 (2007).
2. Satyendra Singh and S.B. Krupanidhi, "Surface spin glass behavior in sol–gel derived La0.7Ca0.3MnO3 nanotubes", Dalton Transactions, 4708–4710 (2008).
3. Satyendra Singh, Satendra Pal Singh and Dhananjai Pandey, "A succession of relaxor ferroelectric transitions in Ba0.55Sr0.45TiO3", Journal of Applied Physics, 103, 016107 (2008).
4. Satyendra Singh and S.B. Krupanidhi, "Synthesis, structural characterization and ferroelectric properties of Pb0.76Ca0.24TiO3 nanotubes", Materials Chemistry and Physics, 131, 443–448 (2011).

5. Satyendra Singh and S.B. Krupanidhi, "Perovskite phase transformation in 0.65Pb(Mg1/3Nb2/3)O3-0.35PbTiO3 nanoparticles derived by sol-gel", Journal of Applied Physics, 111, 024314 (2012).

Glimpses....



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Dr. Bijoy Kumar Kuanr
Associate Professor

Qualifications

Ph. D. (University of Delhi, 1993)

Areas of Interest/Specialization

Spintronics, Magnetic Nanostructures & nano-devices, GMR-Sensor, Microwave Monolithic Nano Devices

Experience

- Post Doc: 1994-1996 - University of Köln, Köln, GERMANY
- Post Doc: 1999 - Ruhr – University of Bochum, GERMANY
- Research Scientist : 1999 - 2001 Research Centre Jülich, JÜLICH, GERMANY
- Senior Researcher : 2001 - 2003 : Center for Magnetism and Magnetic Nanostructures, University of Colorado, Colorado Springs, USA
- Senior Researcher : 2004 - 2013 (May to July every year): Center for Magnetism and Magnetic Nanostructures, University of Colorado, Colorado Springs, USA
- 1989-1998 : Lecturer - Zakir Husain Delhi College, University of Delhi, Delhi
- 1998-2006 : Reader - Zakir Husain Delhi College, University of Delhi, Delhi
- 2006-2013 : Associate Professor - Zakir Husain Delhi College, University of Delhi, Delhi
- Associate Professor SCNS, JNU, New Delhi (07.01.2014 - till date)

Awards & Honours

- Co-researcher of Nobel Laureate Physics 2007 - Professor Peter Grünberg
- DAAD Fellow - Germany - 1994 & 1999
- SERC Fellow (DST, India) 1998
- C.S.I.R. India, Senior Research Fellow, 1988

International Collaboration/Consultancy

- Professor Peter Grünberg - Research Center Jülich, JÜLICH, GERMANY
- Professor Zbigniew Celinski - Center for Magnetism & Magnetic Nanostructures, University of Colorado, Colorado Springs, USA
- Dr. Pavel Kabos, Electromagnetic Division - Advanced High Frequency Devices, NIST, Boulder, Colorado, USA

- Prof. Leszek Malkinski, Advanced Materials Research Institute, University of New Orleans, USA
- Dr. V. Veerakumar - Seagate Technology, Bloomington, Minneapolis, USA
- Professor S. R Mishra - Department of Physics, University of Memphis, Memphis, USA

Best Peer Reviewed Publications (upto 5)

1) Bijoy K. Kuanr, Z. Celinski, and R. E. Camley, "Tunable high-frequency band-stop magnetic filters" Applied Physics Letters, Vol. 83, 3969 (2003).
2) M. Buchmeier, Bijoy K. Kuanr, D. E. Buergler, R. Schreiber and P. Gruenberg "Spin-waves in magnetic double layers with strong anti-ferromagnetic interlayer exchange coupling: theory and experiment", Physical Review B 67, 184404 (2003).
3) Bijoy K. Kuanr, D. L. Marvin, T. M. Christensen,R. E. Camley and Z. Celinski, "High-Frequency Magnetic Microstrip Local Band-pass Filter", Applied Physics Letters, 87, 222506 (2005).
4) Bijoy K. Kuanr, V. Veerakumar, Ryan L. Marson, Sanjay R. Mishra, R. E. Camley and Z. Celinski, "Non-reciprocal Microwave Devices Based on Magnetic Nano-wires" Applied Physics Letters, 94, 202505 (2009).
5) Y. Khivnitsev, Bijoy K. Kuanr, T. J. Fal, M. Haftel, R. E. Camley, Z. Celinski, & D. L. Mills, "Nonlinear ferromagnetic resonance in Permalloy films: A non-monotonic power-dependent frequency shift", Physical Review B 81, 054436 (2010).

Recent Peer Reviewed Journals/Books (upto 3)

1) Bijoy K. Kuanr, R. E. Camley, Z. Celinski, Adam McClure & Yves Idzerda, Single crystal $Fe_{1-x}Ga_x$ thin films for Monolithic Microwave Devices, Journal of Applied Physics, May, vol. 115 (17) pp.17C112 (2014).
2) Monika Sharma, Bijoy K. Kuanr, Manish Sharma, and Ananjan Basu" New opportunities in microwave electronics with ferromagnetic nanowires" Journal of Applied Physics 115, pp.17A518 (2014).
3) Bijoy K. Kuanr, Alka V Kuanr, V. Veerakumar, Sanjay R. Mishra, R. Camley and Z. Celinski, "High frequency study of core-shell and uncoated Fe_3O_4 nanparticles" Journal of Applied Physics, 111, 07B542 (2012).

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Dr. Pratima R. Solanki

Assistant Professor

Qualifications

Ph.D. (MD University, Rohtak, 2009)

Areas of Interest/Specialization

Nanobiosensor, Bionanocomposites

Experience

- Assistant Professor March 2013 onward at SCNS, JNU
- Assistant Professor from 2012- 2013 Amity University, Noida
- Fast Track, Young Scientist, DST: 2009-2012 at National Physical Laboratory, New Delhi
- Senior Research Associate ship/ Pool Scientist from 2006-2009 at National Physical Laboratory, New Delhi
- Research Associate from 2003- 2006 at National Physical Laboratory, New Delhi
- Research Associate from 2000–2001 at Genomics and Integrative Biology, Delhi

Awards & Honours

- Young Scientist –DST Fast Track (2009-2012)
- Senior Research Associateship/ Pool Scientist, CSIR. India (2006-2009)
- Outstanding Paper Award at International Conference on Biomedical and Pharmaceutical Engineering during 11-13 December 2006, Department of Biomedical Engineering, Nanyang University, Singapore

Best Peer Reviewed Publications (upto 5)

* Md. Azahar Ali, Pratima R. Solanki, M. K. Patel, H. Dhayani, V.V. Agrawal, R.John; B.D. Malhotra, A highly efficient microfluidic nano biochip based on nanostructured nickel oxide;*Nanoscale* 2013,5, 2883-2891.

* Pratima R Solanki, A Kaushik, V V Agrawal & B D Malhotra, Recent Advances in nanostructured metal oxides based biosensors. *Nature Asia Materials* 2011, 3 (1), 17.

* Pratima R Solanki, A Kaushik, T Manaka, M K Pandey, M Iwamoto, V V Agrawal, B D Malhotra; Self-Assembled Monolayer Based Impedimetric Platform for Food Borne Mycotoxin Detection. *Nanoscale* 2010, 2, 2811.

* Pratima R. Solanki, A Kaushik, P M Chavhan, S N Maheshwari, & B D Malhotra (2009) Nanostructured zirconium oxide based genosensor for E. coli detection. *Electrochemistry Communication*, 2009, 11, 2272.

* A Kaushik, R Khan, Pratima R Solanki, P Pandey, J Alam, S Ahmad & B D Malhotra Iron oxide nanoparticles-chitosan composite film for application to glucose biosensor. *Biosens Bioelectronics*. 2008, 24 676.

Recent Peer Reviewed Journals/Books (upto 3)

* Pratima R. Solanki, Md. A. Ali, V.V. Agrawal, A.K. Srivastava, R. K. Kotnala, B. D. Malhotra, Highly sensitive biofunctionalized nickel oxide nanowires based immunsensor for cholera detection. RSC Adv., 2013, 3, 16060–16067.

* Md. Azahar Ali, S. Srivastava, P.R. Solanki, V.Reddy, V.V. Agrawal, C.Gi Kim, R. John, B. D. Malhotra. Highly Efficient Bienzyme Functionalized Nanocomposite-Based Microfluidics Biosensor Platform for Biomedical Application. Scientific Report NPG 01/2013; 3:2661. DOI:10.1038/srep02661.

Patents (if any)

Sensitive and specific immunosensor for the *Vibrio cholera* detection. Application No. 3964/DEL/2012; CBR number: 13341, Indian.

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Dr. Balaji Birajdar
Assistant Professor

Qualifications

Ph.D. (University of Tuebingen, Germany, 2008)

Areas of Interest/Specialization

Electron Microscopy, Nanomaterials, Thin films, Ferroelectric materials

Experience

(a) August 2013 onwards, Assistant Professor at SCNS

(b) 2009-2013, post-doctoral fellow at CENEM (center for nanoanalysis and electron microscopy) Erlangen, Germany

(c) 2007-2009, post-doctoral fellow at MPI (Max-Planck Institute) of microstructure Physics, Halle, Germany

Best Peer Reviewed Publications (upto 5)

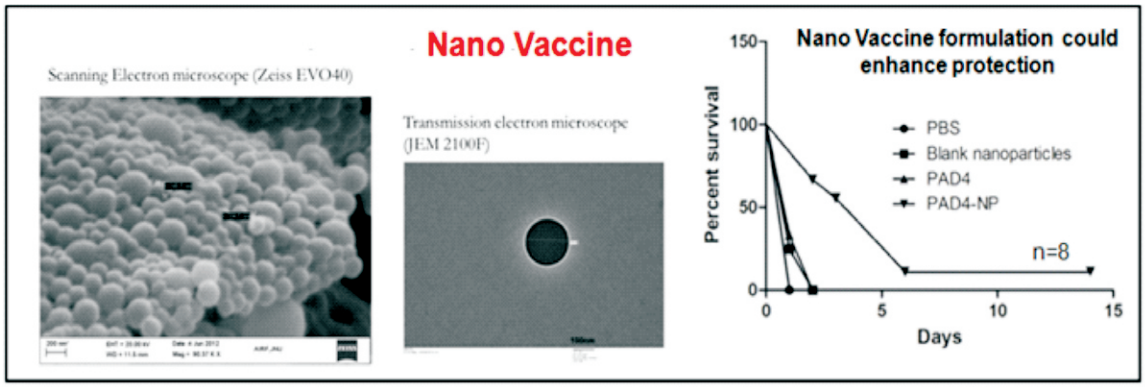
1. B.I. Birajdar, T. Antesberger, B. Butz, M. Stutzmann, E. Spiecker, "Direct in-situ transmission electron microscopy observation of Al push-up during early stages of the Al-induced layer exchange" Scripta Materialia, 66, 550(4pp) (2012)
2. Xingsen Gao, Brian J. Rodriguez, Lifeng Liu, Balaji Birajdar, Daniel Pantel, Michael Ziese, Marin Alexe, Dietrich Hesse "Microstructure and Properties of Well-Ordered Multiferroic Pb(Zr,Ti)O3/CoFe2O4 Nanocomposites" ACS Nano, 4, 1099 (9pp) (2010)
3. B. I. Birajdar, A. Chopra, M. Alexe, and D. Hesse "Crystal defects and cation ordering domains in epitaxial PbSc0.5Ta0.5O3 relaxor ferroelectric thin films investigated by high resolution transmission electron microscopy" Act. Mater. 59, 4030 (13pp)(2011)
4. Birajdar B, Eibl O, "Microstructure critical current density model for MgB2 wires and tapes" Journal of Applied Physics 105, 033903 (12pp) (2009)
5. Birajdar B, Peranio N, Eibl O, "Quantitative electron microscopy and spectroscopy of MgB2 wires and tapes" Supercond. Sci. Technol. 21, 073001 (20pp) (2008) (Topical Review)

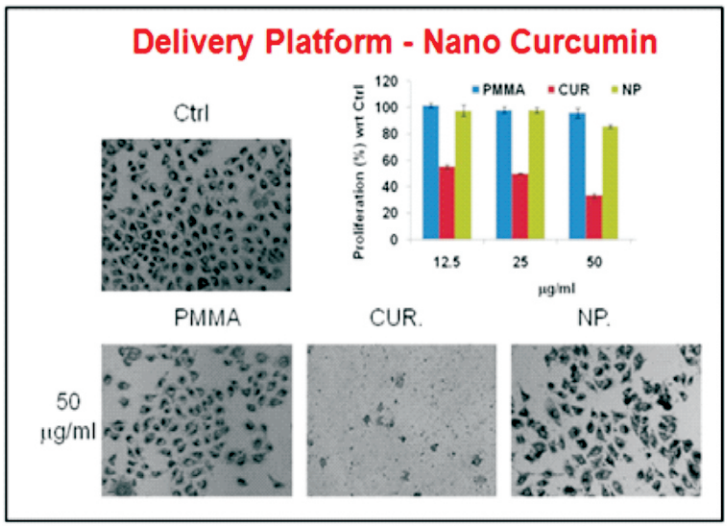
Faculty of the Centre

Recent Peer Reviewed Journals/Books (upto 3)

1. Anuj Chopra, Balaji I Birajdar, Andreas Berger, Marin Alexe and Dietrich Hesse, "Thickness-dependent cation order and disorder in PbSc0.5Ta0.5O3 thin films grown by pulsed laser deposition" New Journal of Physics, in press, (2014)
2. Anuj Chopra, Balaji I. Birajdar, Yunseok Kim, Marin Alexe, and Dietrich Hesse, "Enhanced ferroelectric and dielectric properties of (111)-oriented highly cation-ordered PbSc0.5Ta0.5O3 thin films" Journal of Applied Physics, 114, 224109 (2013)

Glimpses....





Other Active Research Areas in Nano Medicine

- ***Cancer 'theranostics'***
- ***Diagnostics***
- ***Nanoparticle toxicity***

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Dr. Samer Singh
Ramalingaswami Fellow

Qualifications

Ph.D. (Jawaharlal Nehru University, 2003)

Areas of Interest/Specialization

Cancer Biology, Targeted delivery, Vaccine Development,

Experience

(a) 2004 - 2009, Research Associate/ Staff at Dartmouth Medical School, Dartmouth College, Hanover, New Hampshire, USA

(b) 2009 - 2012, Assistant Scientist at Miller School of Medicine, University of Miami, Florida, USA

(c) 2012 - cont., Ramalingaswami Fellow at Jawaharlal Nehru University, New Delhi, India

Awards & Honours

a) 2012: Ramalingaswami fellow

b) 2010: Research paper "Activation of Hedgehog Signaling by the Environmental Toxicant Arsenic May Contribute to the Etiology of Arsenic-Induced Tumors. *Cancer Res*. 2010 Mar 1;70(5):1981-1988" was Highlighted by *Nature* (http://www.nature.com/ nature/journal/v464/n7286/pdf/464144f.pdf)

c) 2006: Research paper "A highly conserved amino-terminal region of sonic hedgehog is required for the formation of its freely diffusible multimeric form. J Biol Chem. 2006 Feb 17;281(7):4087-93" made Cover Image of J Biol Chem. (http://www.jbc.org/ content/281/7.cover-expansion)

d) 2003: UNESCO-ASM Travel Award

e) 2001: Senior Research Fellowship (SRF) UGC-CBT, JNU, New Delhi, India

f) 1998: NET

g) 1997: GATE & Junior Research Fellowship (JRF) UGC-CBT, JNU, New Delhi, India

Best Peer Reviewed Publications (upto 5)

1. Singh S, Wang Z, Fei DL, Black KE, Goetz JA, Tokhunts R, Giambelli C, Rodriguez-Blanco J, Long J, Lee E, Briegel KJ, Bejarano PA, Dmitrovsky E, Capobianco AJ,

Robbins DJ. Hedgehog-producing cancer cells respond to and require autocrine Hedgehog activity. Cancer Res. 2011 Jul 1;71(13):4454-4463.

2. Fei DL, Li H, Kozul CD, Black KE, Singh S, Gosse JA, Direnzo J, Martin KA, Wang B, Hamilton JW, Karagas MR, Robbins DJ. Activation of Hedgehog Signaling by the Environmental Toxicant Arsenic May Contribute to the Etiology of Arsenic-Induced Tumors. Cancer Res. 2010 Mar 1;70(5):1981-1988. Highlighted by Nature (http://www.nature.com/nature/ journal/v464/n7286/pdf/464144f.pdf)
3. Tokhunts R*, Singh S*, Chu T, D'Angelo G, Baubet V, Goetz JA, Huang Z, Yuan Z, Ascano M, Zavros Y, Therond PP, Kunes S, Dahmane N, Robbins DJ. The full-length unprocessed hedgehog protein is an active signaling molecule. J Biol Chem. 2010 Jan 22;285(4):2562-8. (*Equal contribution)
4. Singh S, Tokhunts R, Baubet V, Goetz JA, Huang ZJ, Schilling NS, Black KE, Mackenzie TA, Dahmane N, Robbins DJ. Sonic hedgehog mutations identified in holoprosencephaly patients can act in a dominant negative manner. Hum Genet. 2009 Feb;125(1):95-103.
5. Li N, Singh S, Cherukuri P, Li H, Yuan Z, Ellisen LW, Wang B, Robbins D, Direnzo J. Reciprocal Intra-Epithelial Interactions between TP63 and Hedgehog Signaling Regulate Quiescence and Activation of Progenitor Elaboration by Mammary Stem Cells. Stem Cells. 2008 May;26(5):1253-64.

Recent Peer Reviewed Journals/Books (upto 3)

1. Manish M, Rahi A, Kaur M, Bhatnagar R, Singh S. A Single-Dose PLGA Encapsulated Protective Antigen Domain 4 Nanoformulation Protects Mice Against *Bacillus anthracis* Spore Challenge. *PLoS One*. 2013 Apr 29;8(4):e61885.doi:10.1371/journal.pone.0061885.
2. Kaur M*, Singh S*, Bhatnagar R. Anthrax Vaccines: Present Status and Future Prospects. Expert Rev. Vaccines, 2013 August; 12(8): 955–970 DOI:10.1586/14760584.2013.814860. (* Equal contribution**)**
3. Fei DL, Sanchez-Mejias A, Wang Z, Flaveny C, Long J, **Singh S**, Rodriguez-Blanco J, Tokhunts R, Giambelli C, Briegel K, Schulz WA, Gandolfi AJ, Karagas MR, Zimmers TA, Jorda M, Bejarano P, Capobianco AJ, Robbins DJ. Hedgehog Signaling Regulates Bladder Cancer Growth And Tumorigenicity. *Cancer Research*; 2012 Sep 1;72(17):4449-58.

Patents (if any)

1. *Transformation of an edible crop with pagA gene of Bacillus anthracis*. Indian patent (**2078/DEL/2005; Publication date: 2009-07-31**)
2. *Novel vaccine formulation against anthrax*. Indian patent (**3469/DEL/2012**)

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Dr. Kamla Rawat
Research Associate

Qualifications

Ph.D. (Jawaharlal Nehru University, New Delhi, 2013)

Areas of Interest/Specialization

Bio-polymers, Soft Matter , Nanomaterials and nanocomposites, Low dimensional nano systems, Sensing

Experience

(a) Research Associate (Special Centre for Nanosciences) JNU

Awards & Honours

1. First prize in the poster competition in SPS March Meeting on "Nanoscience & Condensed Matter Interface" School of Physical Sciences, JNU, New Delhi, India, 7th - 8th March 2013
2. First prize in the poster competition (SPS@25: Looking Forward Conference, School of Physical Sciences, Jawaharlal Nehru University, March 2011).
3. First prize in poster competition (Soft Condensed Matter Physics Conference, School of Physical Sciences, Jawaharlal Nehru University, March 2010).
4. First prize in the poster competition (12th CRSI National Symposium in Chemistry, Indian Institute of Chemical Technology, February 2010)
5. CSIR - Junior Research Fellowship (December 2007), India

Best Peer Reviewed Publications (upto 5)

1. Universal Charge Quenching and Stability of Proteins in 1 - Methyl-3-alkyl (Hexyl/Octyl) Imidazolium Chloride Ionic Liquid Solutions, K. Rawat and H. B. Bohidar, J. Phys. Chem. B 2012, 116, 11065- 11074.
2. DNA- Gelatin Complex Coacervation, UCST and First-Order Phase Transition of Coacervate to Anisotropic ion gel in 1 -Methyl-3-octylimidazolium Chloride Ionic Liquid Solutions, K. Rawat, V. K. Aswal, and H. B. Bohidar, J. Phys. Chem. B 2012, 116, 14805- 14816.
3. Effect of persistence length on binding of DNA to polyions and overcharging of their intermolecular complexes in aqueous and in 1-methyl-3-octyl imidazolium

chloride ionic liquid solutions, K. Rawat, J. Pathak and H. B. Bohidar, Phys. Chem. Chem. Phys., 2013, 15 (29), 12262 – 12273.

4. Effect of Solvent Hydrophobicity on Gelation Kinetics and Phase Diagram of Gelatin Ionogels, K. Rawat, J. Pathak and H. B. Bohidar, Soft Matter, 2014, 10, 862-872.
5. TCNQ as a highly sensitive off-the-shelf detector for cyanide with multi-dimensional signal read-out ability, M. R. Ajayakumar, K. Mandal, K. Rawat, D. Asthana, R. Pandey, A. Sharma, S. Yadav, S. Ghosh, and P. Mukhopadhyay, ACS Applied Materials & Interface, 2013, 5 (15), 6996–7000.

Recent Peer Reviewed Journals/Books (upto 3)

Polyelectrolytes: Thermodynamics and Rheology, Visakh P. M., Oguz Bayraktar, Guillermo Alfredo Picó (Springer,Verlag 2014, inpress)

CHAIRPERSONS OF THE CENTRE SINCE THE ESTABLISHMENT

Name of the faculty	Period
Prof. Sanjay Puri	2010-12
Prof. H. B. Bohidar	2012-present

OFFICE STAFF OF THE CENTRE

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Mr. Vishnu
Sanitary Worker

Ms. Mamta
Office Assistant
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Mr. J.P. Narayan
Security Guard

Mr. Girish
Office Attendant

Mr. Ashish
Laboratory Attendant

PRESENT SCHOLARS & STUDENTS OF SCNS

Ms. Anshu (SPS/SCNS)
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"Nanocomposites as biosensors"
E-mail : anshuvishwa@gmail.com

Mr. Rohtash Kumar (SPS/SCNS)
Research Topic
"Nanostructure, dielectric properties"
E-mail : rumar1986@gmail.com

SPECIAL COMMITTEE MEMBERS OF THE CENTRE

The Special Committee of the centre is comprised of several members (who are eminent researchers and academicians) outside and within JNU. The members give their suggestions and recommendations for various academic related matters like designing new teaching courses, upgrading existing teaching courses and approval of Ph. D. synopsis.

1. **Dr. Dinakar Kanjilal,**
   Director Inter-University Accelerator Centre (IUAC),
   Aruna Asaf Ali Marg NEW DELHI - 110067.
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2. **Dr. Rajamani Nagrajan**
   Department of chemistry university of Delhi-07
   Email: rajamaninagrajan@yahoo.com, rnagarajanchemistry@du.ac.in

3. **Prof. Ashuotosh Sharma**
   Department of chemical engineering IIT Kanpur
   Email: ashutos@iitk.ac.in

4. **Prof. Arun K. Atri**
   School of Environmetal Science JNU-67
   Email: attriak@gmail.com

5. **Prof. Rajiv Bhatt**
   School of Biotechnology JNU-67
   Email: rajivbhat@mail.jnu.ac.in

6. **Dr. Sameer Sapra**
   Department of Chemistry, IIT Delhi-16
   sapra@chemistry.iitd.ac.in

Sponsored Research Projects Undertaken

7. **Prof. Amit Dinda**
Department of Pathology,
AIIMS, New Delhi-110029
Email: amit_dinda@yahoo.com, akdinda@hotmail.com.

SPONSORED RESEARCH PROJECTS UNDERTAKEN

COMPLETED PROJECTS

- Preparation and characterization of Bio- polymeric nano-particles with potential for usage in laser immuno-assay and drug delivery. DST Nano-initiative (2005-2009). H. B. Bohidar.
- Encapsulation of potentially immunotherapeutic / immunoprophylactic peptides in novel biocompatible nanosized Carriers for targeted delivery in IDDM, DBT Nanoscience Project (2005-2009), H. B. Bohidar, Anita Verma (Delhi University) and Rajni Rani (NII).

PROJECTS IN PROGRESS

- Gelation Kinetics and Phase Behaviour of Physically Crosslinked Biopolymeric ionogels: DST (2013-2016): H. B. Bohidar.
- Small angle neutron scattering from DNA-Protein coacervates: DAE-IUC (2012-2014): H. B. Bohidar

FACULTY PUBLICATIONS IN NANOSCIENCE -2009 onwards…

1. Nisha Pawar and **H. B. Bohidar**, Hydrophobic hydration mediated universal self-association of colloidal nanoclay particles, Colloids and Surfaces-A, **333** (2009) 120.
2. A. Tiwari, Sonal Bindal and **H. B. Bohidar**, Kinetics of protein-protein coacervation and biphasic release of salbutamol sulfate from coacervate matrix., Biomacromolecules, **10,** (2009) 184
3. Anitha Kumar, **H. B. Bohidar** and A. Mishra,The Effect of Sodium Cholate Aggregates on Thermoreversible Gelation of PNIPAM, Colloids and Surfaces B: Biointerfaces, **70,** (2009) 60-67.
4. **H. B. Bohidar**, Coacervates: A novel state of matter, J. Surf. Sci. Tech., **24,** (2008) 105-124.
5. Amarnath Gupta and **H. B. Bohidar**, Phase separation in aqueous solutions of similarly charged biopolymers, J. Surf. Sci. Tech., **25,** (2009) p9-20.
6. Nisha Pawar and **H. B. Bohidar**, Surface selective binding of nanoclay particles to polyampholyte protein chains, J. Chem. Physics, **131,** (2009) 045103.
7. S. S. Singh, V. K. Aswal and **H. B. Bohidar**, Structural evolution of aging agar-gelatin co-hydrogels, Polymer, **50,** (2009) 5589-5597.
8. S. Boral, V. K. Aswal and **H. B. Bohidar**, Hierarchical structures in agar hydrogels, Polymer, **50** (2009) 5585-5588
9. Nisha Pawar, **H. B. Bohidar**, Spinodal Decomposition and Phase Separation Kinetics in Nanoclay-Biopolymer Solutions, J. Polym. Sci. B, **48** (2010) 555-565.

10. S. Boral and **H. B. Bohidar**, Syneresis in agar hydrogels, Int. J. Biological Macromols. **46,** (2010) 232-236.

11. Pradip Kumar and **H. B. Bohidar**,Aqueous dispersion stability of multi-carbon nanoparticles in anionic, cationic, neutral, bile salt and pulmonary surfactant solutions, Colloid and Surfaces-A, **361,** (2010) 13-24.

12. T. Singh, S. Boral, **H. B. Bohidar** and A. Kumar, Interaction of gelatin with room temperature ionic liquids: a detailed physico-chemical study, J. Phys. Chem. B, **114,** (2010) 8441-8448.

13. M. Kaloti and **H. B. Bohidar**, Kinetics of coacervation transition versus nanoparticle formation in Chitosan-TPP solutions, Colloids and Surfaces-B, **81,** (2010) 165-173.

14. Pradip Kumar and **H. B. Bohidar**, Interaction of soot derived multi-carbon nanoparticles with lung surfactants and their possible internalization inside alveolar cavity, Ind. J. Exptl. Biol., **48,** (2010) 1037-1042.

15. S. Boral and **H. B. Bohidar**,Effect of ionic strength on surface selective patch binding induced phase separation and coacervation in similarly charged gelatin-agar molecular system, J. Phys. Chem. B, **114** (2010) 12027-35.

16. N. Pawar and **H. B. Bohidar**, Statistical thermodynamics of liquid-liquid phase separation in ternary systems during complex coacervation, Phys. Rev. E, **82,** (2010) 036107.

17. M. Kaloti, A. Saxena and **H. B. Bohidar**, Rheological properties of binary and ternary protein-polysaccharide co-hydrogels and comparative release kinetics of Salbutamol Sulphate from their matrices. Int. J. Biol. Macromols. **48,** (2011) **,** 263-270.

18. Kumar, Anitha; Erothu, Harikrishna; **Bohidar, Himadri**; Mishra, Ashok, Bile Salt Induced Aggregation of Poly(N-ISOPROPYLACRYLAMIDE) and Lowering of LCST in Aqueous Solutions, J. Phys. Chem. B, **115,** (2011) 433-439.

19. Ravi Kumar Pujala, Nisha Pawar and **H. B. Bohidar**, Universal sol state behaviour and gelation kinetics in mixed clay dispersions, Langmuir (2011), 27, 5193.

20. Anita Saxena, Mandeep Kaloti and **H. B. Bohidar**, Effect of Agar-gelatin Compositions on the Release of Salbutamol Tablets, J. Pharmaceutical Investigations, (2011), 1, 93-98.

21. Ravi Kumar Pujala, Nisha Pawar and **H. B. Bohidar**, Landau theory description of observed isotropic to anisotropic phase transition in mixed clay gels, J. Chem. Phys. (2011), 134, 194904.

22. Shilpa Sanwlani, Pradip Kumar and **H. B. Bohidar**, Hydration of Gelatin Molecules in Glycerol-Water Solvent and Phase Diagram of Gelatin Organogels, J. Phys. Chem. B, (2011), 115, 7332.

23. Nisha Pawar and **H. B. Bohidar**, Anisotropic Domain Growth and Complex Coacervation in Nanoclay-polyelectrolyte Solutions, Advances in Colloid and Interface Science, (2011) 167, 12-23.

24. S. Santinath Singh, V. K. Aswal and **H. B. Bohidar**, Internal structure of agar-gelatin cohydrogels by light scattering, SANS and rheology, Eur. Phys. J. E (2011), 34, 62.\

25. Ravi Kumar Pujala, Nisha Pawar and **H. B. Bohidar**, Unified scaling behaviour of physical properties of clays in alcohol solutions, J. Colloid and Interface Science (2011) 364, 311-316.

26. Madhusudhana Reddy, P. Venkatesu and **H. B. Bohidar**, Influence of polymer molecular weight and concentration on coexistence curve of isobutyric acid + water, J. Phys. Chem. B (2011), 115, 12065-12075.

27. P. Kumar, R. Meena, R, A. Chanchal, R. Paulraj, A. Kamra, **H. B. Bohidar**, Fluorescence behavior of non-functionalized carbon nanoparticles and their in vitro applications in imaging and cytotoxic analysis of cancer cells, Colloids and Surfaces B: Biointerfaces (2012) 91, 34-40.

28. Kamla Rawat and **H. B. Bohidar**, Low dilution hydration boundary in liquid-liquid phase equilibria of 1-methyl-3-alkyl (hexyl/ octyl) imidazolium chloride ionic liquids, J. Mol. Liquids (2012) 169, 136-143.

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FACULTY PARTICIPATION IN NATIONAL/ INTERNATIONAL CONFERENCES / MEETINGS/WORKSHOPS

- Microwave Planar Non-linear Phase-Shifter in Microstrip Geometry
  Bijoy K Kuanr, Alka V Kuanr, R. E. Camley, Z Celinski
  2103 IEEE AP-S/URSI-USNC Symposium, Orlando, Florida; July/2013

- Permalloy (NiFe) nanometer square-antidot arrays: Dynamic modes and use as a monolithic microwave band-pass filter
  Bijoy K. Kuanr, V. Venugopal, A. V. Kuanr, R. E. Camley, Z. Celinski
  International Microwave Symposium – June/2013, Seattle, USA

- Co nanowires based tunable micro-strip devices at higher microwave frequency range
  Monika Sharma, **Bijoy K Kuanr**, Manish Sharma, Ananjan Basu
  MRS Spring Meeting & Exhibit, (2013), California, USA

Faculty Participation in National/ International Conferences / Meetings / Workshops

- High frequency study of ZnO coated and uncoated $CoFe_2O_4$ nanoparticles
  Bijoy K Kuanr, Alka V Kuanr, Sanjay Mishra, Z Celinski
  Conference on Frontiers in BioMagnetic Particles, June/2013, Colorado, USA

- Magnetically tuned High Frequency Phase Shifter using Fe as active element.
  Bijoy K. Kuanr, V. Venugopal, Y. Khivintsev,R.E. Camley and Z. Celinski.
  55th Magnetism and Magnetic Mat. Conference (MMM-2010), ATLANTA, USA

- Tunable local band pass filter using permalloy square antidote arrays. V. Venugopal, **Bijoy K. Kuanr**, L.M. Malkinski, M.Yu, R.E. Camley and Z. Celinski, 55th Magnetism and Magnetic Materials Conference (MMM-2010), ATLANTA, USA

- High-Frequency Signal Processing using Magnetic Layered Structures.

  R. E. Camley, Z. Celinski, T. Fal, A. V. Glushchenko, A. J. Hutchison, Y. Khivintsev, **Bijoy K. Kuanr**, I. R. Harward, V. Veerakumar, V. V. Zagorodnii.

  43th Annual GOMAC-Tech Conference, MARCH 16-19, 2009 - Florida, USA.

- **Pratima R. Solanki**. National Conference on Biomedical Science and Technology, 2013, National Physical Laboratory, New Delhi during 21-22nd Nov. 2013.

- **Pratima R. Solanki**. India-Japan workshop on Biomolecular electronics and organic nanotechnology for environment Preservation (IJWBME-2013) Delhi Technology University (DTU), Delhi during 13-15th Dec. 2013.

- **Pratima R. Solanki**. National Conference/ workshop on synthesis characterization and application of advanced nanomaterials 2014 at Hindustan college of science and Technology, Farah, Mathura (U.P) during 17-19th Jan 2014

- **Balaji Birajdar**, Simon Kraschewski, Anuj Chopra, Dietrich Hesse, Erdmann Spiecker, oral presentation titled "Advanced TEM characterization of nanomaterials", at National Conference on Synthesis, Characterization and Application of Advanced Nanomaterials held at Hindustan College of Science and Technology NH-2 Farah, Mathura (U.P.), India

- **Balaji Birajdar**, delivered lecture titled "Introduction to Electron Microscopy" in 13th Refresher Course in Physics held at Academic Staff College, J N U, New Delhi, India.

- **Kamla Rawat,** Oral presentation in "International Symposium on Neutron scattering-INSS-2013" in BARC, Mumbai, India during January 14th-17th, 2013.

- **Kamla Rawat,** Presented a poster in SPS March Meeting on "Nanoscience & Condensed Matter Interface" School of Physical Sciences, JNU, New Delhi, India, 7th - 8th March 2013.

- **Kamla Rawat,** Participated *"*Indo-French Technical Summit 2013*"* New Delhi 23th-24th October 2013.

- **Kamla Rawat,** Presented a poster in "*5th Asian Conference on colloid and interface Science"*, Department of Chemistry, University of North Bengal, *Darjeeling, 20-23 November 2013.*

- **Kamla Rawat,** Invited Lecture on 1st International Conference on "Scattering and Diffraction Techniques for Material Characterization (ICSDTMC – 2013)" Rourkela, Orissa from 13th – 15th December 2013 *".*
- **Kamla Rawat,** Invited Lecture on "Refresher course– 2014" Academic Staff College, JNU, Delhi, 3rd – 4th February 2014 *".*

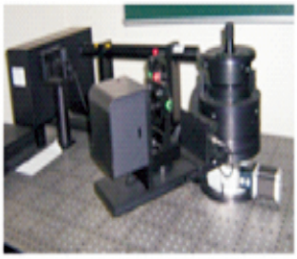
Invited Lecture on "NATIONAL WORKSHOP ON NANOMEDICINE (NWN-2014) "ROLE OF NANOMEDICINES AS THERAPEUTIC AGENTS AGAINST MULTI-DRUG RESISTANT (NWN – 2014)" Integral University, Lucknow from 7th – 9th March 2014 *".*

CORE FINANACIAL SUPPORT TO THE CENTRE

- ✓ UGC : fully supported program under the XIth Five Year Plan
- ✓ DST
- ✓ Ramalingaswami Fellowship, Department of Biotechnology (India); Title: "*A combination therapy for non-small cell lung carcinoma (NSCLC): targeting cancer stem cells and bulk tumor cell population together*" **Amount: INR 82 lakh**; Duration: 2012-2017
- ✓ DBT network project on Brucellosis; Title: "*Development of recombinant Omp25 based vaccine against brucellosis for humans*"; **Amount: INR 1.14 Crore**; Duration 2012-2015

FACILITIES AT THE CENTRE

Presently, the Centre has nanomaterial synthesis and nanobiosynthesis lab consisting of all basic characterization facilities including FTIR-Raman spectrophotometer, laminar hood, BOD incubator, Dynamic Light Scattering, Zeta Potential Measurement, UV-NIR



Dynamic light scattering

Cyclic voltammeter

Viscometer

UV-Vis NIR spectrophotometer

Autoclave

Tensitometer

Easy-Raman

Ultracentrifuge

Micro Centrifuges

Spectrophotometer, Viscometry, Tensiometry etc. andothers like Potentiostat-Galvanostat, Cell culture facility, Fluorescence Spectrophotometer, Contact Angle Measurement will be installed soon. A wide range of analytical facilities including Transmission Electron Microscopy, Scanning Electron Microscopy, Confocal Microscope, and other on-line cell imaging facilities are available at the Advanced Instrumentation and Research Facility, which is the central facility of JNU, and at the School of Physical Sciences.

SUMMER TRAINING PROGRAMME

The centre is providing/ likely to provide a good facility and training to summer students all through these years. The students at graduate or post-graduate levels (including industry) visit from all over the country and abroad to get training in the areas of target specific drug delivery(magnetic nanoparticles), microwave monolithic devices (magnetic nanowires), low dimension nanostructures and their self assembled microstructures, industries dealing with medical and pharmaceutical products, coating and printing materials, agricultural and personal care products, energy storage and harvesting devices, developing smart and compact sensors to check chemical and microbial impurities in water and food etc to make the quality of life better. The possibilities that exist in nanoscience are endless. The tenure of stay is generally from a minimum of 3 months to a maximum of 6 months according to prescribed needs. The centre receives hundreds of applications from aspiring summer trainees every year.

Ms. Sarla
(Nanoparticles)

Ms. Reena
(Biopolymeric Nanoparticles)

Ms. Purnima
(Quantum Dots)

Ms. Dinesh
(Biosensors)

Ms. Yana
(Biosensors)

Ms. Ruchika
(Nanocomposites)

Ms. Dherender
(Ferroelectric Relaxers)

Mr. Sailesh
(Ferroelectric Relaxers)

Mr. Ravi
(Mangnetic Nanoparticles)

Mr. Sweta
(Metal Nanoparticles)