Materials Science Programme
Indian Institute of Technology Kanpur

SESSION 2024-2025

PLACEMENT BROCHURE

Student Placement Office

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VISIT US at https://www.iitk.ac.in/msp/

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WELCOME MESSAGE FROM THE HOD

Materials Science Programme

Indian Institute of Technology Kanpur

"It is clear that the strength of even the largest engineering structure depends in part upon chemical and physical events happening upon a molecular scale and so we shall not only have to let our ideas range freely up and down the scale of physical dimensions from the very big to the very small, but we shall also have to jump backwards and forwards from the ideas of chemistry to those of engineering. In the current phrase materials science is 'interdisciplinary'."

-- From "The New Science of Strong Materials or Why You Don't Fall Through the Floor" by J E Gordon (1963)

The interdisciplinary program on Materials Science continues to keep the spirit of the above-mentioned wise words alive. While these lines were written many decades ago, the ever-expanding inroads of materials into technology have necessitated continued rejuvenation of education and research training in the domain of materials science, engineering and technology. Every student and participating faculty of MSP aims to bring to fruition the spirit of inter-disciplinarity, wherein technical problems are viewed with more than one lens. Students with a wide range of training in their undergraduate degrees-typically from Chemistry and Chemical Engineering, Electrical Engineering and Physics, Mechanical Engineering and Instrumentation-are inducted into MSP and first-year courses are designed for cross-pollination of strengths and viewpoints of different departmental ecosystems. Each course is typically taught by two faculty from two different backgrounds. Students graduate to their second phase in training by taking up research challenges at the interface of different disciplines Such an evolution of students' technical competence makes them ideally suited to wrestle with the many facets of the contemporary industrial material ecosystem, which invariably comprises multidisciplinary teams. We have aspired to inculcate the spirit of lifelong learning in students and we hope such an aptitude will be gainfully employed in your technical troubling environment.

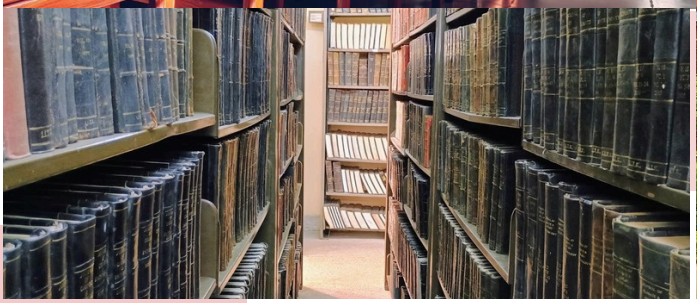
We look forward to your feedback on your technological needs so that we can strategize the training of the next generation of interdisciplinary interlocuters!

Dr. Raj Ganesh S .Pala
Professor and Head,
Materials Science Programme
Indian Institute of Technology Kanpur

About Us







The Interdisciplinary program in Materials Science at IIT Kanpur was established in July 1971 as an early degree program aimed at promoting collaboration across different fields of research and technology. This approach contributes to advancing and enhancing material qualities for several applications, including electronic devices, semiconductors, mechanical systems, nanotechnology, energy storage, stealth technology, and sensing capabilities. Our students engage in a demanding curriculum that includes practical laboratory exercises to characterize different materials' properties. These exercises involve the use of advanced techniques such as Scanning Electron Microscopy (SEM), Raman Spectroscopy, Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), X-Ray photoelectron spectroscopy (XPS), and various other materials characterization techniques. The combination of interdisciplinary knowledge acquired by students throughout their course work and their specialized and in-depth subject expertise gained through Ph.D. study makes them strong candidates for both industry application and academia.. GATE scores and a written exam conducted by IIT Kanpur are the selection criteria for this program.

Courses Offered

MATERIALS ENGINEERING

- **Semiconductor processing methods**
- Solidification.
- **Powder processing**.
- **Crystal growth.**
- Heat treatment.
- **Non destructive evaluation.**
- **Processing of glasses and polymers.**
- Novel processing methods.
- **Thin films.**
- Surface phenomena and **corrosion**.
- **Composites.**

MECHANICAL PROPERTIES of MATERIALS

- Stress & strain tensors & elastic constants.
- Effect of structure on elastic behaviour.
- **Viscosity and viscoelasticity in polymers**.
- Dislocations and plastic deformation of metals and ceramics.
- **Creep, brittle fracture in ceramics and glasses.**
- Fatigue.
- **Mechanical testing**.
- **Strength and engineering design with brittle solids.**

STRUCTURAL AND MAGNETIC PROPERTIES of MATERIALS

- Crystal structure, bonding of atoms & crystal chemistry.
- **Equilibrium thermodynamics, phase equilibria, phase transformations.**
- Dia-, para-, ferro-, ferri-, and antiferro-magnetism.
- Anisotropic effects.
- Magnetic domains, magnetostriction.
- **Measurements of magnetic properties.**
- Soft and hard magnetic materials and their technology.

CHARACTERIZATION of MATERIALS

- Data and Error analysis.
- Crystallography.
- **XRD**.
- **Spectroscopic techniques**-
  - IR, Raman, Microwave.
- Magnetic Measurements.
- **Optical and electron microscopy**
- **Electrical characterization techniques**-
  - Hall effect, Resistivity etc.
- Laboratory sessions.

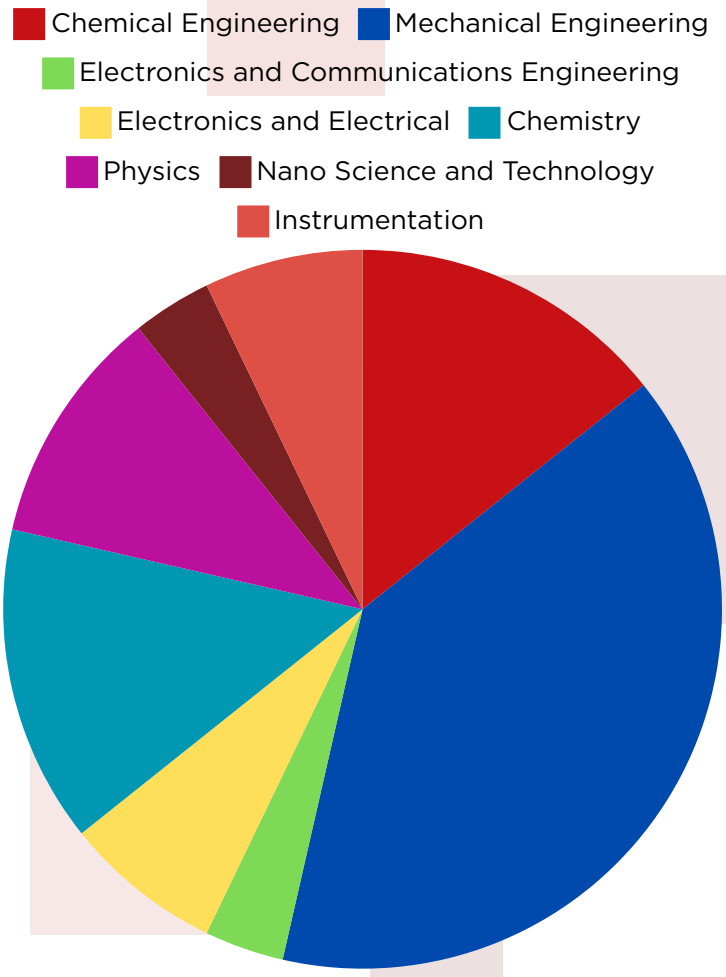
ELECTRICAL AND DIELECTRIC PROPERTIES of MATERIALS

- Free electron theory.
- Metallic conduction.
- Energy bands.
- Brillouin zones.
- Temperature dependence of metallic conductivity.
- **Semiconductor materials & doping effects.**
- P-N junctions, MOS field effect transistors.
- **Di-, ferro-, and piezo- electric materials**
- **Semiconductor technology.**

Elective Courses Offered

- **Engineering polymers**
- **High performance polymers and composites**
- **Materials selection in mechanical design**

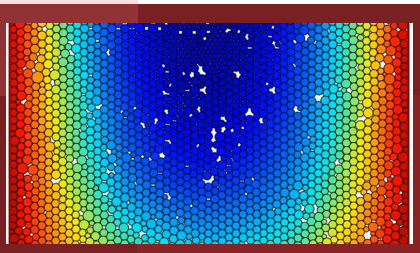
Students' Demography



Research Areas

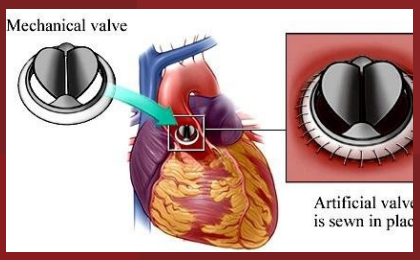
Physics Based Process Modelling of Hot Isostatic Pressing (HIP):

Influence Of hydrostatic Pressure And temperature On consolidation/density distribution.



Innovating Heart Valve Design With Advanced Simulation Techniques:

Our comprehensive approach integrates Ansys simulations, including central composite design and finite element analysis, to optimize heart valve functionality. Coupled with Computational Fluid Dynamics, our studies include detailed stress analyses and calibration studies, ensuring robust performance and reliability for cardiovascular health applications.

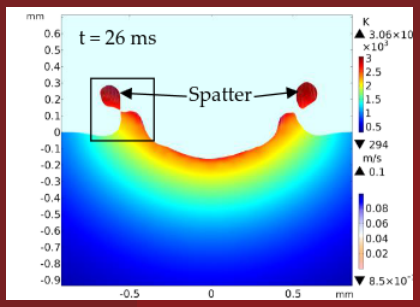


P-type NiO Thin Film Deposition Using RF Sputtering:

This research work is on NiO thin film deposition using RF Sputtering and controlling its doping. Basically this work is based on developing wide band gap semiconductors that are the next generation of power electronics. In this a film of p-NiO will get deposited that will integrate with n-Ga2O3 as pn-diode and will act as a rectifier.

Elevate Aerospace Resilience With Cutting-edge COMSOL Simulations of Laser Damage Potection:

This research utilizes advanced COMSOL multiphysics simulations to investigate the laser ablation of Al2O3 ceramic coatings. By combining numerical simulations with experimental data, we uncover key mechanisms of laser-induced damage, enabling the development of robust protective solutions for aerospace components.

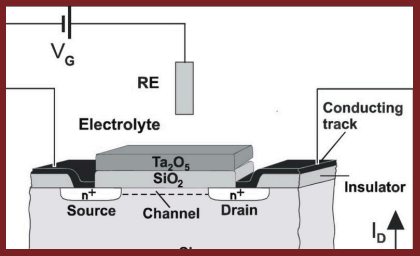


Printing of Bio-impedance Sensor on Textile:

Our groundbreaking research focuses on the development and integration of bio-impedance sensors directly onto textiles, revolutionizing the landscape of wearable technology. By leveraging advanced printing techniques, we seamlessly embed these sensors into fabrics, enabling continuous and non-intrusive health monitoring. This innovative approach not only enhances comfort and wearability but also provides accurate real-time data on physiological parameters such as hydration levels, muscle health, and cardiac activity.

ISFET Based Ion and Bio Sensors:

ISFETs (Ion-Sensitive Field-Effect Transistors) are solid-state devices used for ion sensing in solution. ISFETs operate based on the potential over the oxide-solution interface, allowing for pH sensing and biomolecule detection.



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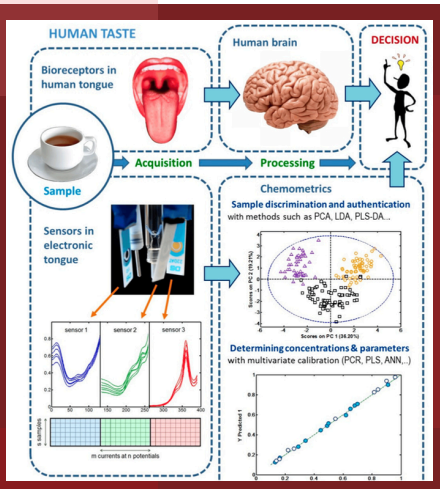
Research Areas

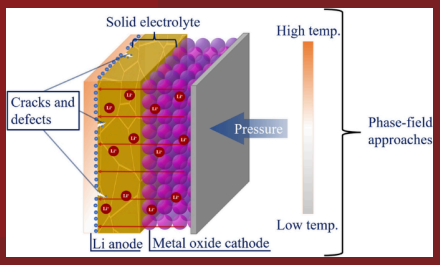
Electro-chemical Impedance analysis on Chemical Taste Sensing, Data Custering by Unsupervised Computer Learning Algorithm:

Classification of drugs, taste based classification of medicinal ingredients on the basis of electro-chemical reactions, data collection and clustering on the basis of principle component analysis and unsupervised learning algorithm.



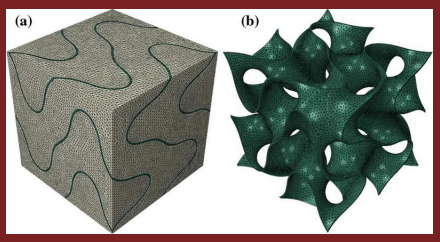
Advanced Phase Field Simulation of Fracture Mechanism for Enhanced Durability of Li-ion Solid State Batteries Using Multiphysics software MOOSE:

Our cutting-edge project leverages the multiphysics software MOOSE to conduct phase field simulations of the fracture mechanisms in Li-ion solid state batteries. By incorporating polymer matrix-based composite solid state electrolytes and utilizing grand potential-based modeling, we aim to significantly enhance the durability and performance of these batteries. This innovative approach addresses critical industry challenges, paving the way for more reliable and efficient energy storage solutions.



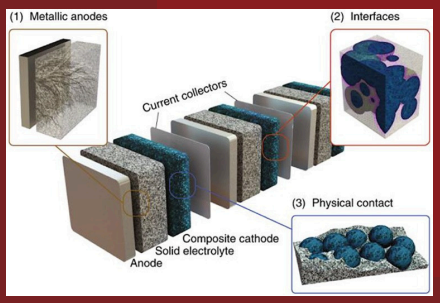
Numerical Modelling of The Micro-structure and Failure of the 3D Pinted Preforms of The Metal-ceramic Composites:

This research deals with 3D printed metal preforms in which Fe models of the units cells fdm software units cells and TPMS structure unit cells will be created and validated with experimental results. Thermo-mechanical stress tensor and thermal conductivity tensor are being used for finding the optimization wall thickness. Simulation will be performed in ABAQUS.



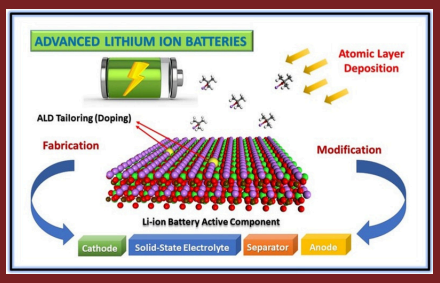
Phase Field Modeling of EEI in Composite Solid State Electrolytes with Nanofibers in a Viscoelastic Matrix Using MOOSE:

This study investigates the temporal evolution of electrode-electrolyte interphase (EEI) in composite solid-state electrolytes embedded with nanofibers within a viscoelastic matrix. Utilizing the Multiphysics software MOOSE and phase field simulation, the research provides insights into the complex interactions and mechanical properties governing the stability and performance of these advanced electrolyte materials.



Novel Materials for Solid State Battery Electrodes:

This research focuses on the development and optimization of solid state battery electrodes, aiming to enhance energy density and cycling stability. this work focuses on investigating novel materials and architectures to improve performance and safety in solid state batteries. This includes the synthesis and characterization of advanced electrode materials, with an emphasis on scalability and industrial applications. Through this research, the end goal is to contribute in this field by exploring innovative solutions to address current challenges in electrode design and functionality.



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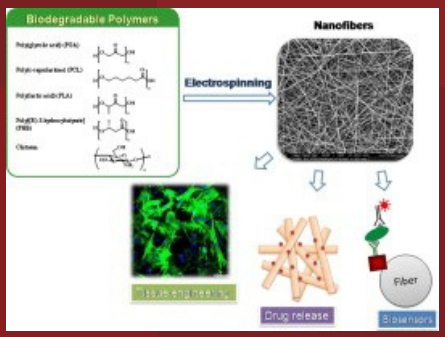
Research Areas

Synthesis of Electromagnetic Interference Shielding Materials and SImulation by Using CST Microwave Software:

This research on electromagnetic shielding materials utilizes advanced characterization techniques such as XRD, SEM, TEM, Raman spectroscopy, EDS, and UTM for precise evaluation and optimization. With EMI shielding effectiveness measured across a broad frequency range and simulations conducted using CST Microwave Studio, this project aims to develop innovative solutions for wearable electronics, flexible devices, defense equipment, and medical instruments, offering significant advancements for industry partners.

Electrospinning of Polymers:

This research deals with pioneering electrospinning research to develop nanofibrous polymer materials with exceptional properties for transformative applications in energy, filtration, and biomedicine.



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Lab Facilities

OPTICAL SPECTROSCOPY

Experimental condensed matter physics with emphasis on using spectroscopy tools such as Raman scattering to probe the nanoscale dynamics in novel and interesting materials
Location : ACMS 107

THIN FILMS LABORATORY

Nano, electronic, magnetic recording and hydrogen energy storage materials, Thin films, Electron microscopy
Location : ACMS 108B

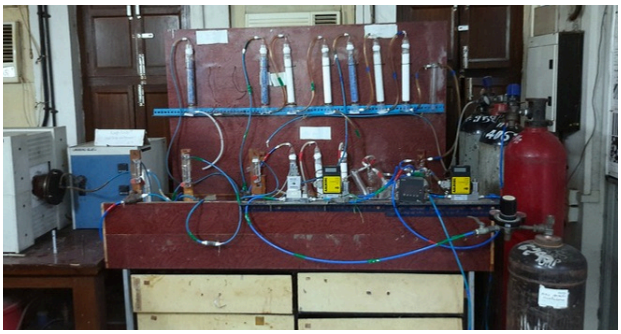
MICROWAVE MATERIALS PROCESSING LABORATORY

Microwave absorbers, Microwave sensors, Stealth technology, Dielectric properties
Location: ACMS 207A

Lab Facilities

MATERIALS SCIENCE INSTRUCTIONAL LABORATORY

Nano, electronic, magnetic recording and hydrogen energy storage materials, Thin films, Electron microscopy
Location : ACMS 210



ADVANCED NANOENGINEERING MATERIALS LABORATORY

Carbon nanotubes, Nanostructured materials, Functionally graded materials, Fuel cell, Solar cell, Li-battery, Polymer, Thermoelectric materials, Nanocomposites
Location : ACMS 208

Faculty list

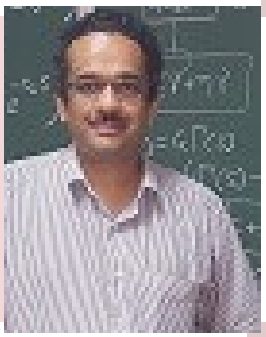
Dr. Raj Ganesh S Pala
Professor and Head, PhD (Physical Chemistry), University of Utah
Research Interest : Electrochemical , Catalysis and Separations Engineering

Dr. Rajeev Gupta
Professor
PhD, IISc Bangalore
Research Interest : Experimental condensed matter physics

Dr. Sri Sivakumar
Professor ,Ph.D., University of Victoria, Canada
Research Interest: Synthesis and Characterization of Nanomaterials, Novel nano-catalyst

Dr. Y. N. Mohapatra
Professor
PhD, IISc Bangalore
Research Interest : Printable Electronics and nano patterning

Dr. Amit Verma
Associate professor
PhD, University of Notre Dame, IN, USA
Research Interest : Materials Growth for semiconductor device fabrication, characterization and modeling



Dr. Yogesh M Joshi
Professor
PhD, IIT Bombay
Research Interest: Structure and dynamics of Colloidal Glasses and Gels, Soft Matter, Rheology of Complex Fluids, Polymer Science and Engineering, PolymerNanocomposites

Dr. Kamal K Kar
Professor, PhD,
IIT Kharagpur
Research Interest : Materials for solar cell, fuel cell, lithium battery, high performance structural composites

Dr. M. Jaleel Akhtar
Professor, PhD, University of Magdeburg , Germany
Research Interest : Microwave imaging and non-destructive testing , RF and microwave sensors

Dr. Siddhartha Panda ,
Professor
Ph.D., Chemical Engineering, University of Houston
Research Interest : Chemical sensors, Transport and reactions Microfluidics Micro/nano fabrication Semiconductor devices

Dr. Pritam Chakraborty
Associate Professor
PhD, The Ohio State University, USA
Research Interest : Solid mechanics to understand plasticity, fatigue, creep and fracture from a micro-structural length scale

Dr. Ashutosh Sharma
Professor
PhD, State University of New York at Buffalo
Research Interest : Soft nanofabrication, Mechanics, patterns and instabilitie, Functional and nano-materials

Distinguished Alumni

Manvendra Bhangui
Founder, Indimail

Rajiv Arya
Founder, Arya International

Ivan Saha
CEO , Vikram Solar

Amitabh Verma
VP. -Aditya Birla Management Corp. Pvt. LTd.

Past Recruiters

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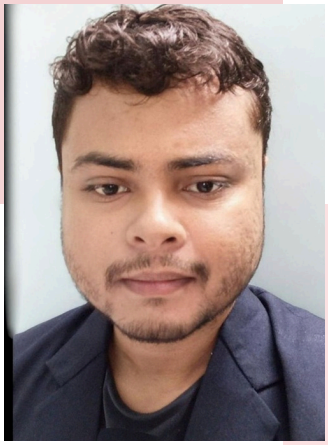

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