Faculty

- ***Balasubramaniam R:*** Materials-Hydrogen interaction, Corrosion & oxidation, Archaeometallurgy.
- ***Bansal V:*** Solidification of Metals and Alloys, Foundry Technology, Metal Matrix Composites.
- ***Basu B:*** Structural Ceramics, Tribology of Advanced Materials, Composites.
- ***Bhargava S:*** Materials Synthesis, P/M Processing, Thermomechanical Processing, Intermetallics and Nanostructured Materials.
- ***Biswas K:*** Solidification, Electron Microscopy, Phase Transformation, Nanomaterials
- ***Brahma Deo:*** Process Control and Process Optimization in Iron and Steel-Making.
- ***Dube RK:*** Powder Metallurgical Processing, Composite materials.
- ***Garg A:*** Materials Processing by Solid State Chemistry, Ferroelectric Ceramics, Thin Films.
- ***Gauthama :*** Electron Microscopy, Grain Boundary Engineering, structure-Property Correlations
- ***Gupta D:*** Electromagnetic Processing and Modelling, White Light Illumination, Display Technology.
- ***Gupta SP:*** Phase Transformations.
- ***Katiyar Monica:*** Thin Film Technology, Characterization and Applications of Opto-Electronic materials & Devices.
- ***Koria SC:*** Injection Metallurgy, Transport Phenomena in Metallurgy.
- ***Majumdar D:*** Heat, Mass and Momentum Transfer in Metallurgical systems.
- ***Mehrotra SP:*** Process Design and Development.
- ***Misra BK:*** Modeling & Simulation of Mineral Processing Systems.
- ***Mondal Kallol :*** Phase Transformation, Corrosion, Oxidation, Non-equilibrium processing, Metallic glass and Nanocrystalline alloys.
- ***Sharma RC:*** Thermodynamics and Kinetics of Phase Transformations, Heat Treatment.
- ***Shekhar R (Head):*** Electrochemical Cleaning of Soil, Aluminium Electrolysis, Electrodeposition, EIA.
- ***Sangal S:*** Microstructural Characterization, Stereology.
- ***Upadhyaya A:*** Materials Processing, Liquid Phase Sintering, Alloy Design.

Contact
Head
Department of Materials and Metallurgical Engineering
Indian Institute of Technology
Kanpur-208016
INDIA
Tel.: 91-512-2597640
Fax: 91-512-2597505/2590007
Email: vidtan@iitk.ac.in
Website: www.iitk.ac.in/mme/

Indian Institute of IITK Technology Kanpur

Materials & Metallurgical Engineering

The Department of Metallurgical Engineering was set-up at IIT Kanpur right at its inception in 1960. While retaining its strength in traditional areas of metallurgical engineering, the department grew with time reflecting the needs of a changing society and established new areas of research and teaching in Materials Science. Keeping up with this change, the name of the department was changed as the Department of Materials and Metallurgical Engineering (MME) in 1993. With a growing number of both undergraduate as well as postgraduate students, today the department of MME organizes teaching of courses and undertakes major research programme in the areas spanning from mineral engineering and extractive metallurgy and processing and characterizing of metallic materials, intermetallics, ceramics and composites. Recent periods have seen a growing emphasis on opto-electronic and spin device materials and nano-materials technologies. Having a strong base in teaching of fundamentals through its curricula, the department has always played a dominant role in developing mathematical models of processing of materials by various routes. Thus, since its inception, the department has been very active in Teaching, R&D and Consultancy activities.

Areas of Research

The department is actively engaged in the following major research and development areas-

- *Extractive & Process Metallurgy*
- *Design, Processing and Characterization of Metallic Materials*
- *Intermetallics, Ceramics and Composites*
- *Electron and Spin Device Materials*
- *Nano-materials Technologies*
- *Computational Materials Science*

Facilities Available

Some of the major equipments and facilities available in the Department are as follows:

Mineral Engineering and Extractive Metallurgy

- High Intensity Magnetic Separator, Crushers, Ball Mills and Jigging Facilities
- Semi-Automatic Floatation Cell
- Hydro-Cyclone Test Rig
- Sieve Size Analyzer for Sampling
- Wet Chemical Analysis Laboratory

Processing of Materials through Liquid, Solid, Vapour and Powder Processing Routes:

- Set-up for Directional Solidification
- Oil-fired, Electric and Induction Melting Furnaces, Sand Testing Facilities, Sand Casting and Foundry Facilities
- Pneumatic Hammers, 200 T and Lower Capacity Hydraulic Presses, 2-High Rolling Mill with Facility to Roll Porous Metals under Inert Atmosphere Cover
- Swaging Mill
- Cold Isostatic Press
- Melt Atomization Facility (In-House Construction)
- Several Heat Treatment and Sintering Furnaces
- Hot Press for Consolidating Powder Materials
- Sintering including Microwave Sintering Facilities for Ceramic Materials
- Basic Processing for Electronic Materials including Clean Benches, Spin Coater, Furnace, Lithography, CVD Reactor, E-beam Evaporation

Characterization of Structure, Phases, Mechanical and Opto-Electronic Properties

- Transmission and Scanning Electron Microscopes, Metallographic Facilities including an Image Analysis System
- Electron Probe Microanalyzer (EPMA), X-Ray Diffraction Facility
- Thermogravimetric Analyser; Dilatometry Facilities
- Low, Ambient and High Temperature Testing Facilities for Tensile, Fatigue and Creep Tests
- Hardness, Microhardness and Impact Testing Facilities
- Friction and Wear Testing Facilites
- Pin-on-Disk Wear Tester for Testing under Cryogenic Environment
- Powder Characterization Facilities for Powder Materials

PRODUCTS, PROCESSES & SOFTWARE

P/M speciality metal strips such as alumina dispersed copper strip, diamond dispersed bronze strip and multilayered metal strip
Mechanical seals
Improved P/M cutting tool materials
Rare earth-mish metal permanent magnets
Single roll continuous sheet caster
Novel metal - matrix particulate composites
Cement from rice husk
Electroless nickel coating

Sponsored Research Projects

A large number of research projects have been sponsored by various organizations to the Department. Some of the sponsored research projects, either continuing or undertaken in the recent past are as follows

- Development of Diagnostic Tools for Tumbling Mills (DST)
- Development of Powder Metallurgy Metal Ceramic Composite (MHRD)
- Development of High Density P/M Ferrous Alloys for Automotive Applications (AICTE)
- Layered Ceramic Composites (BRNS)
- Hydride Formation in TiAl (INSA)
- Hydrogen Attack in Carbon Alloyed Iron Aluminides (DRDO)
- Superplasticity in Ceramic Matrix Composites (DST)
- Hydrogen Embrittlement of Aluminium - Lithium Alloys (ARDB)
- Processing of Metal Matrix Composites (DAE)
- Mathematical Modelling of Continuous Casting of Steel Sheets (NMIS)
- Phenomenology and Rheology of Plastic and Superplastic Deformation under different loading Conditions for Materials Applications (DST)
- Low- and High-Cycle Fatigue Behaviour of Two-Step Cooled Medium Carbon Microalloyed Steels (DST)
- Defects in GaAs (AICTE)
- Blanked Tungsten CVD for Microelectronic Interconnects (DST)
- Investigation of Tungsten and Tungsten Silicide Thin Films (MHRD)
- Doping of GaN using Ion Implementation (DST)
- Ohmic Contacts to GaN (MHRD)
- Corrosion Behaviour of Light Galvanic Couples (General Motors)
- Electroremediation of Heavy Metal Contaminated Soils (MHRD)
- Investigation on Wear of Solid Lubricated Bearings for LUX and Lh2 Cryo-Turbo Pumps of Liquid Rocket Engines (ISRO)
- Electrodeposition of Magnetic Multilays with High Gaint Magnetoresistance (ARMREB)
- Control of Superheat in Continuous Casting Molds Through a Hollow Jet Nozzle (DST)
- Development of Magnetic Nano-Structures Using e-Beam Deposition for Sensors (MHRD)
- Design and Development of Shaped Tube Pulse Electrochemical Machining for Drilling Deep Microholes in Inconel Alloy (DST)
- Molten Salt Electrodeposition of Rare Earths and Actinides (DAE).
- Development and Characterisation of TiB2 Based Materials for High Temperature Applications (DAE)
- Superheat Control in Continuous Casting through the Application of Hollow Jet Technology (DST)
- Luminescent Materials based on O-Conjugated Linear Si Backbone Polymer Synthesis and Evaluation (DRDO)

Consultancy Projects

- Development of a Flowsheet for the Processing of Kiriburu Iron Ore Fines (SAIL)
- Development of Simulation Tools for Hydrocyclone and its Validation (Tega Industries Ltd.)
- Optimization of Bronze Powder Manufacturing Process (Orion Metal Powders, Pvt. Ltd.)
- Structural Investigation of Generator Failure (NTPC)
- Shaft Failure Analysis (NTPC)
- Failure Analysis of Super Heater (Indo-Gulf Fertilizer Corpn.)
- Cracking Defect in Bronzes (RMG Electronics)
- Hydrogen Embrittlement of Sleeper Steel (Gen. Engg. Works)
- Failure Investigation of ThermoWall Tubes (Indogulf Fertilizers)
- Failure Analysis of an Ammonia Storage Tank (Iron Products Ltd.)

- Failure Analysis of FD Fan Blade (NTPC)
- Ferro Alloys Consumption in Steel Making (Central Excise)
- Development of S.G. Iron (Simplex Casting)
- Drawability of High Carbon Wire Rods (Visakhapatnam Steel Plant)
- Dephosphorisation in BOF Vessel (TATA Steel)
- Microvave Sintering of Metallic PM alloy (BHEL)
- Water Modelling of Ispat Tundish for Better Process Perfomance (Ispat Ind)
- Corrosion of DO-228 Aircraft Components (HAL)
- Offline Dynamic Model of BOF Steelmarking (TATA Steel)
- EIA of Thermal Power Plants emission (IDFC)
- Sintering Studies on SH737 Alloy (Hoeganeas, USA)

PATENTS

The following patents have been awarded/filed:

- A Process of Preparing a Superplastic Alloy Al-Cu-Zr.
- Development of a process to melt, Cast and roll and aluminium alloy equivalent to AFNOR 7020 to obtain properties stipulated by the Indian Space Industry.
- Development of a Suitable Thermo-mechanical Treatment to Induce Superplasticity in a Laboratory made Aluminium Alloy Equivalent to AFNOR 7020.
- An improved organic light emitting diode, an improved organic light emitting diode for tuning the white emission and a process for favrication thereof.
- Corrosion Resistant Phosphoric Iron for Concrete Embedment and Reinforcement.

Books

Some of the recent publications from the Department are as follows:

- R Balasubramaniam, Story of the Delhi Iron Pillar, Foundation Book, New Delhi, 2005
- R Balasubramaniam, The Word Heritage of the Qutub, Aryan Books International, New Delhi, 2005
- SP Gupta, Phase Equilibria in Materials, Allied Publishers, New Delhi, (2003)
- SP Gupta, Solid State Phase Transformations, Allied Publishers, New Delhi, (2003)
- R Balasubramaniam, Delhi Iron Pillar: New Insights, Indian Institute of Advanced Studies, Shimla and Aryan Books International, 2002.
- Ahindra Ghosh, Introduction to Metallurgical and Materials Thermodynamics, Prentice Hall of India, New Delhi, 2002.
- RK Ray, VSR Murthy, NK Batra, KA Padmanabhan and S Ranganathan, Materials for the Third Millenium, Simultaneously published by Oxford and IBH Publishing Co. Pvt. Ltd. and Science Publishers Inc, Enfield, USA, 2001.
- KA Padmanabhan, RA Vasin and EU Enikeev, Superplastic Flow: Phenomenology and Mechanics, Springer Verlag, Berlin-Heidelberg-New York, 2001.
- Ahindra Ghosh, Secondary Steelmaking Principles and Applications, CRC Press, Boca Raton, Florida, USA, 2000.
- GS Upadhyaya, Sintered metallic and ceramic materials, Preparation properties and applications, John Wiley & Sons Limited, Chichester (U.K.), 1999.
- RK Ray and AK Singh, Textures in Materials Research, Simultaneously published by Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi, 1999.
- P Assis, B Deo, D Mazumdar and N Chakraborty, Modelling and Simulation in Iron and Steelmaking, Revista Escola de Minas, Quro Preto, Brazil, 1998.
- GS Upadhyay, Cemented Tungsten Carbides: Production properties and testing, Noys Publiscations, Fairfield, New Jersy, USA, 1998.
- GS Upadhyaya, Powder Metallurgy Technology, Cambridge International Science Publishing, Cambridge, U.K., 1997.
- RC Sharma, Principles of Heat Treatment of Steels, New Age International Pvt. Ltd., New Delhi, 1996.
- Brahma Deo and Rob Boom, Fundamentals of Steel Making Metallurgy, Prentice-Hall Inc., London, 1993.
- A K Jena and M C Chaturvedi, Phase Transformations in Materials, Prentice-Hall Inc., New Jersey, 1992.