Innovating Minerals & Materials Technology for a Green Sustainable World

सीएसआइआर-खनिज एवं पदार्थ प्रौद्योगिकी संस्थान

CSIR-Institute of Minerals and Materials Technology

Bhubaneswar-751013, Odisha, INDIA

Director's Message

CSIR-IMMT has been engaged in nation building ever since it has come into existence in 1964 with a mandate to carry out translational research to help industry grow in terms of scale and newer products, niche basic science where India requires fundamental understanding of the technology before taking commercial activities, propagate research culture in the country, disseminate knowledge and training of manpower. The state of Odisha and adjoining states are rich in huge mineral deposits. With India's growth projected at about 8% and more in the coming years and as the requirement for metals goes up, there is a great opportunity to exploit mineral resources to give marketable raw metals to finished products using flowsheet which ensure minimum environmental damage.

The Institute has excellent R&D facilities accross the complete value chain from minerals to materials including handling of waste & recovery of values from secondary sources. It covers (1) Mineral processing, (2) Extractive Metallurgy, (3) Advanced Processess for special materials, (4) Environment & Sustainability, (5) Design & Enginnering to address the needs of industries in solving their problems with an interdisciplinary as well as holistic approach. This document provides a glance of the R&D activities & capabilities available in this premier national Institute.

Many challenging R&D activities are currently under way in the institute which has direct relevance & linkage to our country's industrial development. These include iron ore palletization, reduction roasting, red mud processing for further extraction of values, potential phosphate fertilizer from LD slag, polymetallic nodule extraction, rare earth element extraction, functional coating technology, slurry transport and stacking etc. We would like to build a strong alliance with our industrial customers and various R&D - academic institutions to take up bigger R&D programs of national & strategic significance. Side by side, we are also making effort to reach out to the poorest of poor to improve their socio-economic condition through appropriate S&T interventions involving multi-institutional framework to develop entrepreneural spirit and activities through creativity & innovation. IMMT's Business Development Group is developing an incubation park to foster lab to land linkage while providing attractive support to interested techno-preneurs. We are setting up Centres of Excellence to promote resources utilization efficiency & circular economy in mineral & metallurgy related materials so that there is growth with due care to environmental sustainability. This will try to address major environmetal issues associated with iron & steel industry and aluminium production, two major industrial sectors in this region. We are also working on utilization of our low grade coal for metallurgical purposes to improve the competitiveness of our industries. There is a great challenge in the current global warming context necessitating R&D on carbon sequestration & carbon neutral energy technologies. Sky is the limit to these endless possibilities and opportunities. I invite the industries to be a partner in the exciting journey.

Jai Hind !

Prof. Suddhasatwa Basu

Director, CSIR-IMMT

MINERAL PROCESSING DEPARTMENT

"One Stop Solution to Mineral Processing Problems"

CORE EXPERTISE

- Physical, chemical and mineralogical characterization of ores and minerals.
- Bench scale to continuous pilot plant studies for beneficiation of low and lean grade ores and minerals.
- Briquetting, sintering and pelletization of iron / chromite / manganese ores and waste generated from integrated steel plants.
- DRI and smelting of iron, chromite and ilmenite ore.
- Basic engineering for commercial plant based on pilot plant data.
- Preparation of techno-economic feasibility report (TEFR) for setting of commercial beneficiation and pelletization plant
- Technical assistance for detailed engineering
- Participation and support during commissioning of commercial plants
- Process simulation and optimization of existing beneficiation and pelletization plants
- Human Resource Development: Post-Graduate Diploma in Mineral Engineering and training of Industry Professionals

MAJOR FACILITIES

Characterization

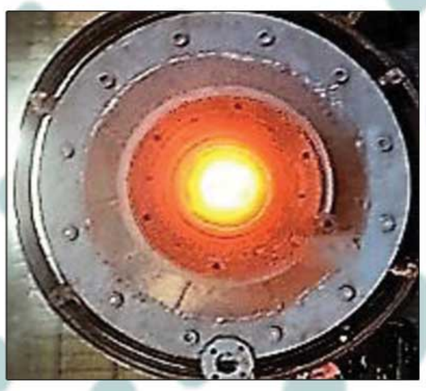
MLA; ICP (OES); ICP (MS); C-S analyser; TGA; CHNS analyser; U-V spectrometer; Heating microscope; XRD; XRF; BET surface area; Particle size analyser; Pellet porosity meter; Compressive strength; CSR CRI; Bomb calorimeter; SEM etc.

Comminution & Classification

Jaw crusher; (lab to pilot scale); Roll crusher; (lab to pilot scale); HPGR; (large scale); Ball mills; (lab to pilot scale); Planetary ball mill; Palla mill; Stirred mill; Screens; Sieve bends; Hydrocyclones; CTS screens; VSK separator; Air classifier; Fluidised bed classifier; Hydrosizers; Screw classifiers

Separation & Beneficiation

Spirals: (Denver; Downer EDI; Multotec Mineral Technologies); Jigs: (Denver;Alljigs; CSIR-IMMT; Kelsey)Heavy media bath; Heavy media cyclone; Triflow separator; Multi-gravity separator; Falcon separator; Knelson concentrator; Gravity tables; Mineral separators; Air dense media fluidised bed separator; Fluidized bed separator; Flotex density separator; Allflux separator; HGMS: (Sala, Longi)WHIMS: Jonnes, Gaustec, Box magnetic separator; MIMS: Humboldtz, IMS; LIMS: Eriez, Sala, InSmart; Dry Magnetic Separator: Humbolt Permoroll, Belt magnetic separator;High tension separator; Tribolelectrostatic separator; Rotary Kiln



TECHNOLOGY & SERVICES

Beneficiation of low & lean grade Iron Ores: Comprehensive utilization plan for Indian iron ore lumps, fines, slimes, tailing, BHQ, BHJ, BGQ by conventional as well as a novel process of reduction roasting followed by magnetic separation.

Pelletization of Iron Ore fines: Process for pelletization of high LOI, fragile and high Blaine number iron ore suitable for DRI making & Blast furnance

Graphite Processing: Innovative approach for production of high flake graphite, high pure graphite & graphene oxide

Processing of Industrial Minerals: Lime stone, dolomite, phosphate ore, barite

Processing of Ferrous Minerals: Chromite, Manganese

Processing of Nonferrous, Precious, PG & Beach sand minerals: Bauxite, Copper Lead Zinc Ores, Platinum group of minerals, Beach sand, Tungstun, Nickel, Niobium

Coal Characterization & Beneficiation: Washability, Proximate, Ultimate, GCV, Reactivity, Grindability Analysis, Beneficiation of coking and non-coking coal, recovery of carbon values from washery waste.

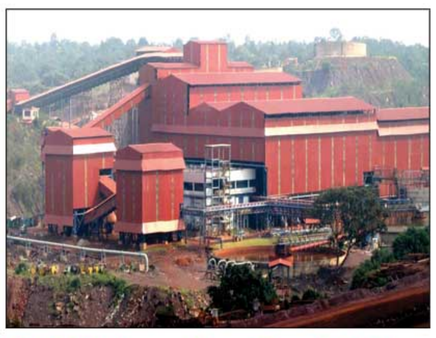
Processing of Industrial Waste from Metallurgical Plant: Recovery of Iron and Carbon values from steel plant waste, briquetting and pelletization of steel plant waste for recycling in the process.

Dewatering studies: Vaccum and pressure filtration, thickening using gravity & magnetic techniques

Design & development of Equipment: Flotation column upto 2.5 m column dia., 10 m high, Screw Scrubber, Pneumocell, Hydraulic Jig

Engineering Support: Plant audit & optimization, Support in commissioning, Basic engineering, TEFR, detailed engineering based on pilot plant data of beneficiation & pelletization plants

OUR ACHIEVEMENTS

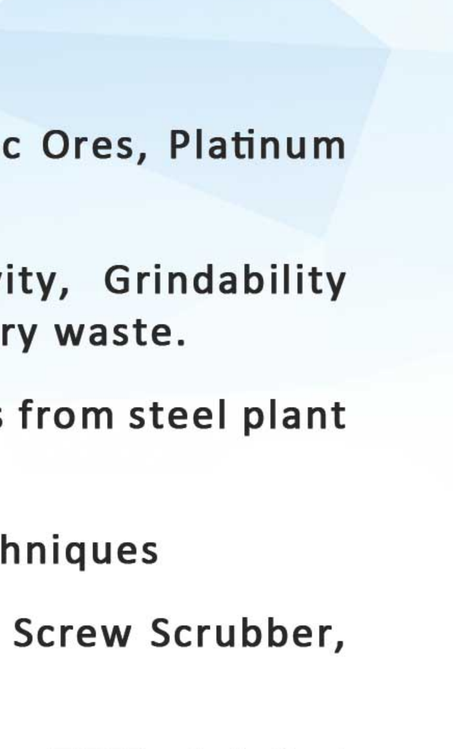


15 MTA Iron Ore Beneficiation Plant of SMPL at Barbil

15 MTA Iron Ore Beneficiation Plant of ESSAR Steel Barbil

Column flotation trial at TATA Steel & JSPL

Modified hydraulic jig



IMMT Screw Scrubber

INDUSTRIAL PARTNERS

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HYDRO & ELECTROMETALLURGY DEPARTMENT

"Enhancing India's capability in Non-ferrous Metals/Compunds"

EXTRACTION OF NON-FERROUS **METALS** FROM

- Ores & concentrates
- Lean, complex & off-grade ores and minerals
- Wastes of metallurgical & allied industries

OUR **EXPERTISE**

Recovery of base, rare earth, critical and strategic metals: Copper, Zinc, Nickel, Cobalt, Vanadium, Molybdenum, Tungsten, Lead, Tellurium, Selenium, Galium, Palladium, Lithium, Samarium, Neodymium, Lanthanum, Europium & values from Alumina from scrap, low grade ores, mine waste, metallurgical waste, effluents, slimes & sludge, battery waste, E-waste, spent catalysts & seabed minerals

Production of high pure materials: $Ni(OH)_2$ for Ni-Cd and Ni-MH batteries, EMD for batteries, $Co(OH)_2$ for Li ion batteries, Al_2O_3 for catalyst, printing ink, activated Alumina, other materials or environmental applications.

Leaching, Solid-Liquid Separation & Chemical Precipitation: Metallurgical Thermodynamics, Heterogeneous Kinetics, Solid-Liquid Interface Phenomena, Rheology

Purification: Liquid-Liquid Equilibrium, Emulsion Breaking, Regeneration of Solvent, Membrane Selection & Casting, Solvent Extraction (SX), Ion-exchange, Supported Liquid Membrane, Reverse Osmosis, Nano Filtration and Ultrafiltration

Electrowinning (Electroprecipitation): Oxygen Anode and Oxide Electrolytes in Fused Salt Electrolysis, Electrode Kinetics,Corrosion Principles in Electroleaching, Redox Systems

Project Engineering: Transport Phenomena, Process Control, Mechanical designs, Pilot Scale Testing & Scale-up, Costing-Heat & Material Balances, Basic & Detailed engineering of extractive metallurgical unit operations

OUR **FACILITIES**

Atmospheric & Pressure Leaching: Batch Autoclaves (500 ml–100 L), Stirred Tank Reactors (500 L – 2500 L)

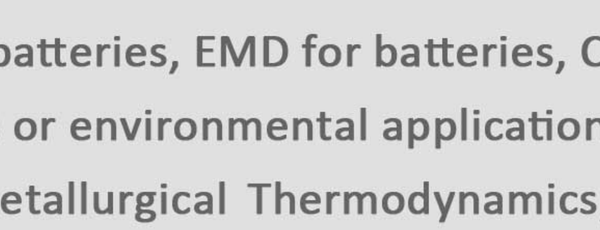
Solid-Liquid Separation: 1 ton Filter Press

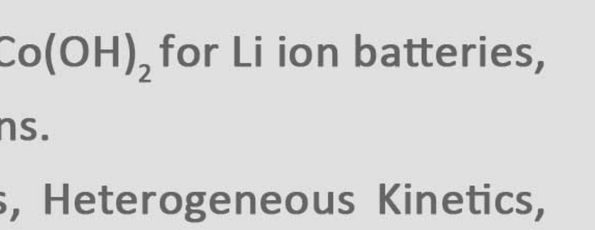
Solvent Extraction: Mixer Settler (25 Stages 200 L/h aqueous SX Unit)

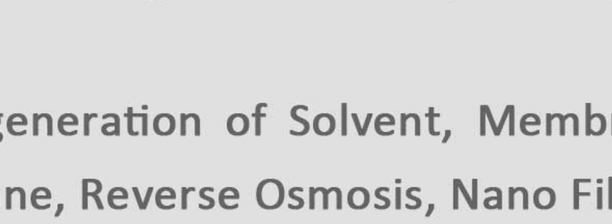
Electrowinning: Electrolytic cell capacity ~100 kg/day

Membrane Technology: SLM (6 L/h), RO, NF & UF membrane (1kL/h)

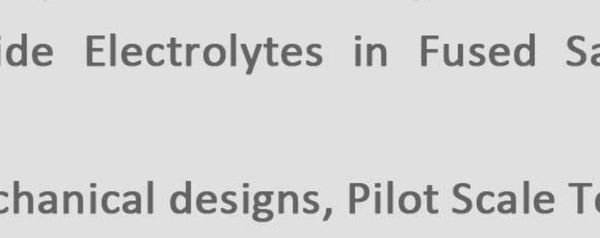
Furnaces: Induction Furnace, Muffle Hydrogen Tube Furnace, Fluidised bed furnace

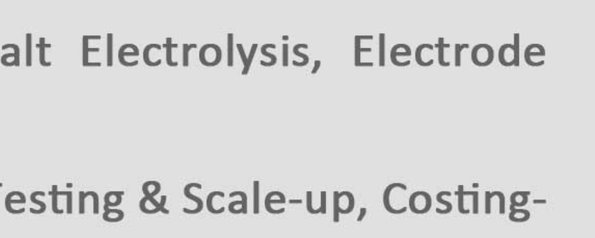

100 L Autoclave for Pressure Leaching


26 Stages 200 L/h Aqueous SX Unit


RO, Nano, Ultra, Membrane filtration system


Induction Furnace


Integrated setup for analysis of fluids at micro scale


Fluidized bed furnace

immt

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TECHNOLOGY/PROCESS **KNOWHOW TRANSFERRED**

Electrolytic membrane process for conversion of effluent Na_2SO_4 to NaOH & H_2SO_4 (Heavy Water Board, Mumbai)

Destruction of nitric acid in high level liquid waste using diaphragm-less electrolysis (3.5 Lph, IGCAR, Kalpakkam)

Recovery of tellurium, lead and copper from anode slimes (M/s Hindalco Ind. Ltd, Birla Copper Unit, Dahej)

Recovery of Nickel from refinery spent electrolyte (150 m3/day, M/s Hindalco Ind. Ltd, Birla Copper Unit, Dahej)

Recovery of Co from Co sludge/scrap (100 tpa Co, M/s Rubamin Ltd., Baroda)

Extraction of Zn and Cu from brass ash, Zn ash (105 tpa Zn & 30 tpa Cu, M/s Pantnagar Fertilizers, Muzaffarnagar)

Recovery of Co from Co bearing slag of South Africa (135 tpa Co carbonate, M/s Shalina Trading Co Pvt. Ltd., Mumbai)

Recovery of Cu and Zn from spent catalyst (75 tpa Cu & 75 tpa Zn, M/s S K Enterprise, Kanpur)

Recovery of cobalt from β-cake leach liquor (18 tpa, M/s HZL, Udaipur)

Electrolytic reduction of ferric to ferrous in phosphoric acid (10000Lph, HWB, Mumbai)

TECHNOLOGY AVAILABLE

Nickel from chromite overburden

Cu, Ni, Co &Mn from polymetallic nodules

Electrolytic chromium and iron powders

Superfine and white ATH from Bayer liquor

Battery grade nickel hydroxide from nickel sulphate / nitrate and EMD from the resources

Nickel from spent catalyst

Zinc oxide and copper sulphate from secondaries

COLLABORATION

IIT Kanpur

Technical University of Berlin, Germany Sofia University , Bulgaria

University of Ilorin, Nigeria

Murdoch University, Western Australia

Korea Institute of Geoscience & Mineral Resources (KIGAM), South Korea

CURRENT **RESEARCH**

- **Technology development (Metallurgy) of Polymetallic Nodules (PMN), MoES, New Delhi**
- **Extractive Metallurgy of Polymetallic Hydrothermal Sulphides (PMS) and Polymetallic Cobalt Crusts (PCC), MoES, New Delhi**
- **Recyclability strategy or value-added utilization of iron/manganese ore tailing/ low grade ore: evaluation of energy storage capacities, MoM, New Delhi**
- **Extraction of Tungsten values from Hutti Gold Mine Tailings concentrate and Scrap, DMRL, Hyderabad**
- **Technology development for production of Li-ion battery grade Electrolytic Manganese Dioxide (EMD)**
- **Scale up & engineering of Bench Scale Demonstration Unit for production of Sodium hydroxide and sulphuric acid from sodium sulphate effluent.**
- **Electrochemical process for improving productivity of alumina in Bayer liquor, NALCO, Bhubaneswar**
- **Recovery of alumina from NALCO fly ash: modifications and validation of flow sheet , NALCO, Bhubaneswar**

WASTE RESOURCES

Chromite Overburden, Leach Residue, Dross, Sludge, Scrap, Tailing, Slag, Effluent, Slime, Spent Catalyst, Spent Battery, Fly-Ash, Dust

PRODUCTS

Cu, Ni, Co, Zn, Te, Se, W, Cr, Sb, Pd, V_2O_5, MoO_3, Al_2O_3, $Ni(OH)_2$, EMD, PbS, Li_2Co_3, Nd_2O_3, La-Ce-Nd-Dy mixed oxide

ADVANCED MATERIALS TECHNOLOGY

Innovation center for Plasma Processing

Alloy, Metal & Composite development

INNOVATING ADVANCED **PROCESSES FOR INDUSTRIAL & STRATEGIC MATERIALS**

- Plasma processing of minerals, wastes and special materials.
- Metals & alloy making through powder processing & other novel routes.
- Production of carbide, oxide and nitride powders including ultrafine and nano powders.
- Microstructural and physical properties studies of defects reduced natural gems.
- Advanced characterizations of special and advanced materials.

OUR **EXPERTISE**

1. Plasma Processing

- Hydrogen plasma for reduction of oxides
- Green steel production
- Speciality materials development: Carbides and Nitrides from ores and wastes
- Coatings: Wear resistant (Diamond, Thermal barrier, SiC, Multilayer nano structured coatings etc.)
- Waste treatment: Industrial and agricultural wastes, e-wastes etc.

2. Energy Materials Synthesis

- Bi_2Se_3, $SnSe_2$, PbSe etc.

3. Strategic and Precious materials production

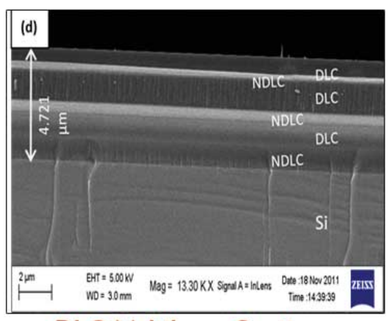
- Graphene and Graphene oxide, ODS ferritic steel, Cu based ultra high vacuum materials, Scandate material, Tungsten alloy cubes etc.

4. Nano materials synthesis

- SiC, AlN, CNT, TiO_2 etc.

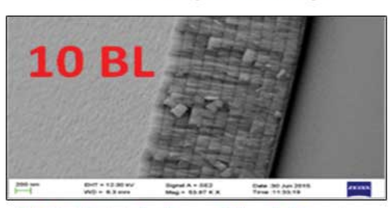
5. Processing of Gem stones for aesthetic improvement & value addition

Tungsten Alloy Cubes



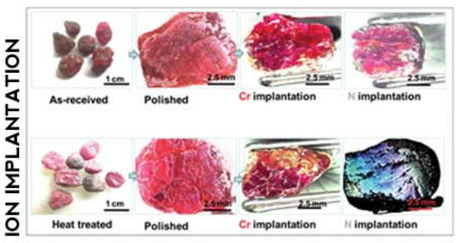
DLC Multilayer Coating

ODS Ferritic Alloy

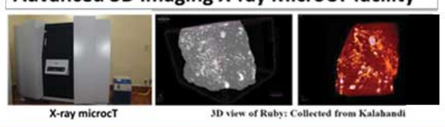


WN-Ni Multilayer Hard Coating

Processing of Natural Gemstones



Advanced 3D imaging X-ray MicroCT facility



X-ray microCT — 3D view of Ruby: Collected from Kalahandi

OUR **ACHIEVEMENTS**

- Jet-wheel impact atomization based spray dryer for spheroidization of alumina, funded by BRNS, Mumbai
- Production of synthetic rutile & pig iron from ilmenite concentrate using thermal plasma, funded NMDC, Hyderabad
- Preparation of synthetic rutile by plasma smelting of ilmenite followed by acid leaching, funded by BRNS, Mumbai
- Thermal plasma synthesis of SiC, WC and TiC, funded by DST, New Delhi
- Development of Ni containing steel from chromite overburden, funded by Ministry of Mines
- Preparation of Titanium Carbite powder from redmud using thermal plasma reactor, funded Vedanata Ltd.
- Preparation of Fe-P powder for coating applications, funded by TATA steel
- Processing of Natural Gemstones for asthetic impovement and value addition, funded by CSIR New Delhi
- Hydrogen Plasma Smelting Reduction (HPSR) of iron ore, funded by Ministry of Steel
- Novel Aluminium Alloys for Automotive & general engineering applications, funded by CSIR New Delhi
- Cu-Mo alloy for high power microwave tubes, funded by CSIR New Delhi

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OUR **FACILITIES**

PROCESSING

Thermal Plasma Reactor, Plasma Spraying facility, Plasma Reactor for nano powder synthesis, Pulse laser deposition unit, Plasma enhanced chemical vapour deposition unit, Microwave Sintering Unit High Temperature and High vacuum furnace, Dual drive planetary ball mill, Hydrogen Plasma Reduction Unit, RF/DC magnetron Sputtering unit, 100 Ton Hydraulic Press, Vacuum induction melting furnace

CHARACTERIZATION

Micro-CT, X-ray Photoelectron Spectroscopy, Electron Probe Micro Analysis, Instron, In-flight particle diagnostics, Micro Raman Spectroscopy, Thermo-electric set up, Mercury Porosimeter, Dilatometer, Thermal Conductivity measurement unit, Ellipsometer, Nanoindentation system, Pin On Disc Sliding wear measurement apparatus, Air jet Erosion Tester, Dry and Slurry Abrasion tester

Hydrogen Plasma Reactor

In-flight thermal plasma reactor

Universal Testing Machine

Product: 7Kg of High Purity Iron

TECHNOLOGY AND SERVICES

- HIgh Purity Iron by Hydrogen Plasma Smelting Reduction of Iron Ore
- Thermal barrier coatings for aerospace and automobile industries
- Plasma sprayed Ceramic Coating on Agricultural Tools & Utensil
- PACVD of diamond and diamond like carbon (DLC) coating
- Preparation of high density Tungsten alloy of shapes & sizes
- Processing of low grade Natural gemstones for aesthetic value addition
- Mechanical testing of metallic materials towards determining its Tensile & Compressive strength, Super plasticity deformation, fatigue properties, crack growth rate, Fracture toughness etc.

OUR **PARTNERS**

TATA STEEL

JSL JINDAL STAINLESS

BHUSHAN

UNSW SYDNEY

vedanta

Leibniz Institute for Solid State and Materials Research Dresden

प्लाज़्मा अनुसंधान संस्थान
Institute for **Plasma Research**

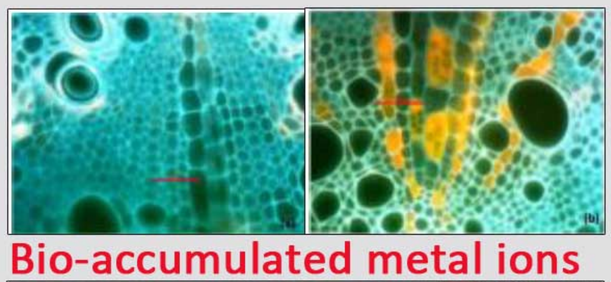
MATERIALS CHEMISTRY DEPARTMENT

Cutting-edge Research in Colloids and Functional Materials

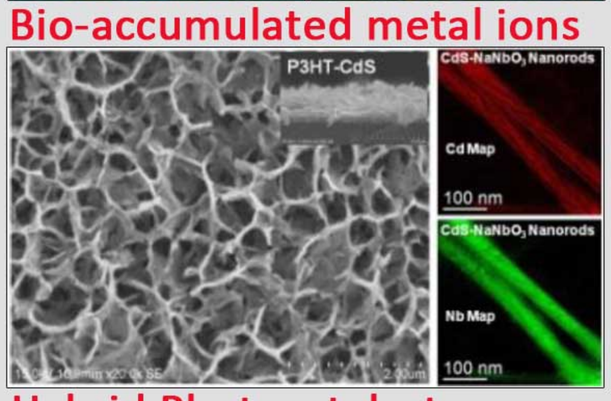
- Soft chemical synthesis of new materials
- Functional, hybrid composite and smart Coatings
- Energy Materials for harvesting, conversion and storage
- Bio-inspired Hybrid Functional Materials
- Environmental pollution abatement such as CO_2 sequestration, waste water treatment and sensors for detection of heavy metal contaminants

OUR **EXPERTISE**

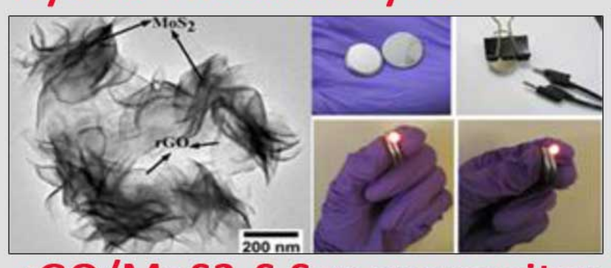
- **Coatings (Corrosion resistant, Erosion/wear resistant, thermal barrier, super hydrophobic, biocompatible):** Sol-Gel, Spin coating, Electrophoretic Deposition, Dip coating, Chemical Bath Deposition, Electroless deposition
- **Soft-chemical Synthesis of New Materials:** Hydrothermal, sol-gel, solid-state synthesis, combustion synthesis etc of organic, inorganic and hybrid materials (semiconductors, ferroelectric, supramolecular complexes, porous frameworks).
- **Tuning structures & functional properties:** Functionalization, nano-structuring, engineered nanoparticles
- **Advanced Characterization:** XPS, TEM, SEM, NMR, FTIR
- **Energy materials:** Development of solar fuel producing devices and solid oxide fuel cell.
- **Transparent conducting thin films** and nanocomposite coatings.
- **Biocompatible coating:** Hydroxyapatite and TiO_2 coating on metal based bio-implant.
- **Design of luminescent probes** for sensing and selectivity application.
- **Fabrication of chemo/bio-sensors** with fast response and ultra-sensitivity.
- **Design of various kind of organic semiconductor** and polymeric electrolytes.



Bio-accumulated metal ions



Hybrid Photocatalysts

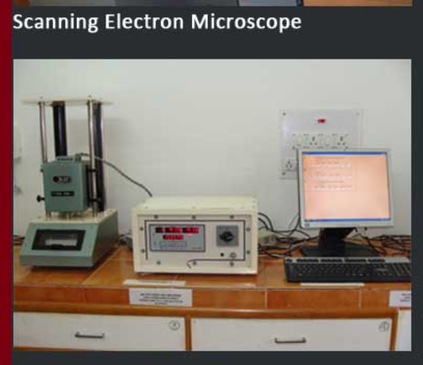


rGO/MoS2-S Supercapacitor

OUR **FACILITIES**

- Scanning Electron Microscope (Hitachi 3400)
- Nano- size Particle Analyzer (Nanotrac 150)
- Scanning Probe Microscope (Nanotec)
- Surface Area and Porosity Analyser (Micromeritics 2020)
- Fluorescence Spectrophotometer (Fluoromax-4P/Perkin-Elmer)
- Fluorescence Optical Microscope (Nikon 80i)
- Nanosight Nanoparticle Analysis System (LM10- Nanosight Ltd)
- Gas Chromatograph (Schimadzu)
- DR- Uv-Vis Spectrophotometer (Schimadzu / Perkin-Elmer / Agilent)
- Rheometer (MCR-300)
- Potentiostat (Amel 7050 / Versastat 300)
- Impedance Analyser (Amel 7260)
- Electrophoretic Deposition Set Up
- Langmuir Film Balance (Apex- 2004 C)
- Spin Coater (Scu 2005)
- Particle Charge Detector (PCD-03-pH)
- Temperature Programmed Desorption / Reduction / Oxidation Unit (AutoChem 2920/Micromeritics)

Scanning Electron Microscope

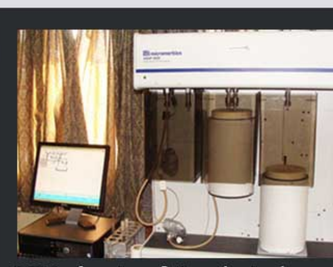


Thermo Gravimetric Analyser

Desorption Reduction Oxidation Unit

Fluoroscence Optical Microscope

FTIR Spectrophotometer



BET Surface Area & Porosity Analyser

Rheometer

Nanoparticle Analysis System

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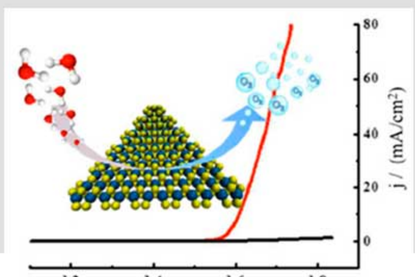
OUR **TECHNOLOGIES**

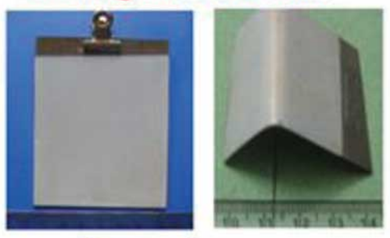
- Electrophoretic Deposition for Industrial Application.
- High temperature diffusion conducting ceramic coatings on steel by electrophoretic deposition for active corrosion protection.
- Super hydrophobic coating of ceramic-polymer nanocomposite for corrosion prevention.
- Graphene reinforced polymer nanocomposite as environmental barrier coating
- High performance intermediate temperature Solid oxide fuel cells (SOFC) by low cost ceramic processing techniques.
- Heterojunction semiconductor photo-catalyst.
- Supercapacitor for Electrochemical energy storage application
- Bio-compatible coating on metal implant for prevention of corrosion
- Nanostructured materials for multifunctional applications-for anti-corrosion, anti-frost, anti-fog, anti-finger print, fire-retardant coating,
- Energy efficient nanostructured coating material for facile electron emission and photovoltaic application
- Microbial resistant nanostructured coating for clean water technology.
- Materials for Supercapacitor Applications (Higher specific capacitance (1315 F g−1), long-term operational durability higher specific energy and power output.
- Sensors for detection of heavy metal ion contamination
- Solar Fuels (Solar to chemical fuel conversion) by device/process based on earth abundant materials.
- Quantum size particle of earth abundant element MoS_2 for energy conversion applications
- Electrochemical sensors and biosensors based on integration of nanoparticles and enzymes on graphene for detecting bio-analytes and environmental contaminants.
- Magnetic Refrigerant Materials: A gas-free, eco- friendly solution for cooling applications
- Porous Organic Polymer (POP) based Sorbents for high capacity gas storage application.
- Anode supported proton conducting solid oxide fuel cells (SOFC).
- Photo functional Materials for Industrial Dye Mineralisation



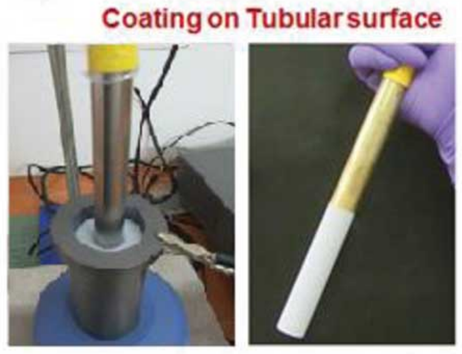
Quantum size particle of MoS_2

ELECTROPHORETIC **COATING**

Coating on Flat surface



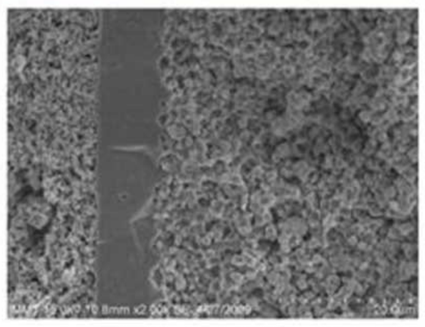
Coating on Tubular surface



TiO2 Coating

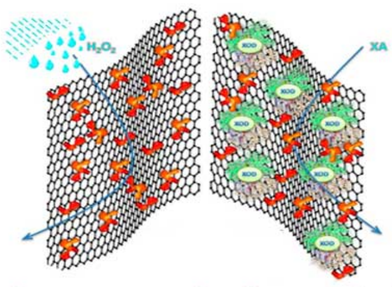
- 2100 hrs salt spray test
- Nanoindentation hardness: 1 GPa

SOFC single cell (20 mm dia)



LSM:YSZ (50:50)/YSZ/NiO-GNP:YSZ (60:40); EPD: 50V, 180 sec, Acetylacetone; Sintering:1450 °C, 5h

Thin & dense coating of Electrolyte for SOFC



Graphene-Branched PtNs-hybrid Sensor/Biosensor

INTERNATIONAL **PARTNERS**

- Nano Ceramics Center, National Institute for Materials Science (NIMS), Tsukuba, JAPAN.
- Center for Innovative Fuel Cells & Battery Technologies, Georgia Institute of Technology, Atlanta, USA.
- Brandenburgische Technische Universitaet (BTU), Cottbus, GERMANY.
- Dept. of Chemical System Engineering, The University of Tokyo, JAPAN.
- Institut fuer Technische Chemie, Leibniz Universitat, GERMANY.
- Nagoya University, JAPAN

NATIONAL **PARTNERS**

- Naval Materials Research Laboratory, Mumbai
- Bhabha Atomic Research Center, Mumbai
- Institute of Physics, Bhubaneswar
- Central Drug Research Institute, Lucknow
- Tata Iron and Steel Company, Jamshedpur
- Centre for Cellular and Molecular Biology, Hyderabad
- Tata Institute of Fundamental Research, Mumbai
- IISc, Bangalore

DESIGN & PROJECT ENGINEERING

OUR **EXPERTISE**

- Hydraulic Transportation of minerals/ores/industrial waste slurries through pipes at high solids concentrations.
- Rheological characterization of minerals, ores and industrial wastes.
- Design of combustion & Gasification systems.
- Evaluation of pollution load & emission control measures for industrial boilers.
- Drinking water purification and Post-harvest technologies.

OUR **FACILITIES**

- High Concentration Slurry Transportation Pipe test Loops (50mm & 100 mm NB pipes).
- Low Concentration Slurry Transportation Pipe test Loops (50 mm & 100 mm NB pipes).
- Pipe test Loops for vertical transportation of slurries (75 mm & 100 mm NB pipes; 20 m high)
- HAAKE RheoStress 1 rheometer (Couette Type).
- Tube Viscometer.
- HORIBA LA-960 Laser Scattering Particle Size Distribution Analyzer.
- Advanced Biomass/Coal/Industrial Waste Gasification system.
- High temperature Syngas Analyser.
- Drinking water testing lab.
- Demonstration Centre for Appropriate Technologies.

TECHNOLOGY & **SERVICES**

- Technical support & basic engineering for designing of commercial slurry pipelines.
- Rheological characterization of minerals, ores and industrial wastes.
- Entrained flow gasification system for biomass/coal/industrial waste.
- Terafil water purification system.
- Water Quality Testing.
- Post-Harvest Technologies: Paddy Thresher, Spice heating system, Biomass, Solar & Hybrid Dryers.
- Biomass operated bakery oven.
- Improved multi-fuel cook stove.
- Licensing & Technology Transfer of appropriate technologies.
- Skill development on production of “Terafil” & other appropriate technologies.
- Demonstration, Training & Dissemination of appropriate technologies.


High Concentration Slurry Transportation Facility


Low Concentration Slurry Transportation Facility


Vertical pipe loop test facility


Haake Rheostress1 Rheometer


Tube Viscometer


Syngas Analyser

Hydrogen gas Analyser

HORIBA LA-960 Particle Size Analyzer

immt

DIRECTOR
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High Concentration Slurry Transportation set-up

Low Concentration Slurry Transportation set-up

Vertical pipe loop test set-up

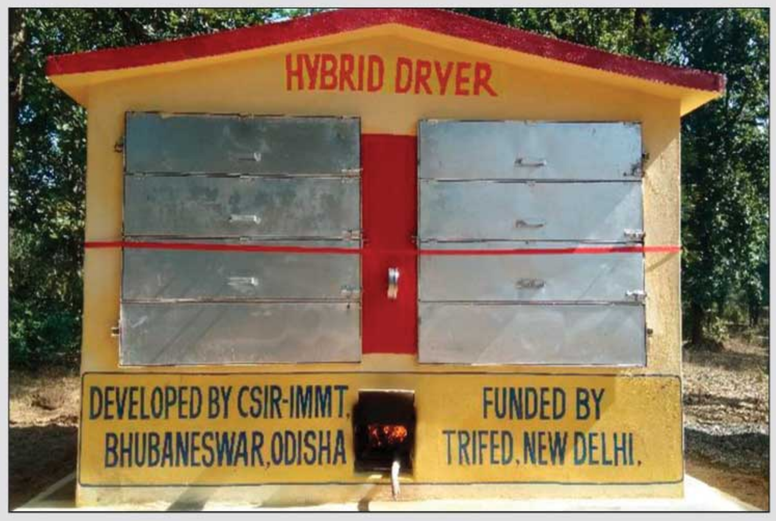
Biomass Gasification system

Coal Gasification system

Biomass Dryer

1000L FRP Terafil water filters

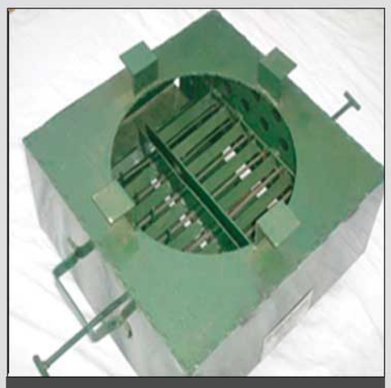
1000L FRP Terafil water filters



Hybrid Dryer

Paddy thresher

Domestic Terafil water filters



Improved Cook Stove

Bakery oven

OUR **ACHIEVEMENTS**

- Basic design and engineering of high concentration slurry disposal system has been provided to more than 25 Indian Coal fired Thermal Power Plants.
- Different Rural Technologies have been transferred to approx. 150 MSMEs/NGOs/Govt. agencies. The list of technology transfers are:

Terafil water filter	: 115	Biomass/hybrid Dryer	: 06
Improved cook stove	: 14	Pottery Kiln	: 04
Paddy thresher	: 03	Bakery oven	: 08

- Around 1.0 Lakh domestic filters & 30 thousand community purification plants have been installed across India.
- Around 5000 domestic filters have been distributed during natural calamities: Bihar Flood (2008), Cyclone Aila in West Bengal (2009), Uttarakhand Flood (2013), Cyclone Phailin in Odisha (2013), Kashmir Flood (2014), Chennai Flood (2015), Kerala flood (2018) etc.
- Biomass & Hybrid dryers have been installed at 7 different tribal areas of four states for efficient drying of Minor Forest Products (MFPs).

INDUSTRIAL **PARTNERS**

एनटीपीसी NTPC
एन एम डी सी N M D C
JINDAL STEEL & POWER
ADITYA BIRLA HINDALCO
TATA STEEL
ESSAR
Adhunik POWER
नालको NALCO National Aluminium Company Limited
MECGALE PNEUMATICS PVT. LTD.
JSW
HINDUSTAN COPPER LIMITED (A Government of India Enterprise)
HINDUSTAN ZINC
बी एच ई एल BHEL
MACAWBER
सिपेट CIPET

ENVIRONMENT & SUSTAINABILITY

FOCUS **AREA**

- Monitoring and abatement of environmental pollution in the vicinity of industries, mines, ports, ocean including urban & rural areas.
- Basic and Applied research for utilization of bio-resources.

OUR **EXPERTISE**

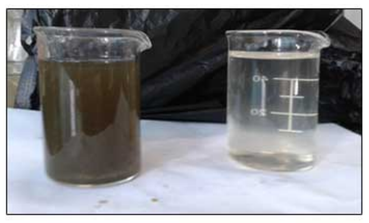
- Monitoring & assessment of coastal environment
- Atmospheric pollution & aerosol monitoring
- Environmental Impact Assessment study
- Industrial solid waste utilization
- Waste water treatment
- Bioremediation
- Defluoridation of portable water
- Construction materials from fly ash, red mud and other industrial wastes
- Green synthesis of nanoparticles and their applications
- Bioleaching of metals
- Bio-fuel from microalgae
- Biodiversity assessment
- Self-assembled DNA nanostructures for bio-therapeutics
- Water quality assessment

Bioleaching of Chalcopyrite

Micro-algae Raceway Pond

Collection of Fluoride water

Bio-Polymer Beads for Fluoride Adsorption



Constructed Wetland for Waste Water Treatment

OUR **ACHIEVEMENTS**

- Monitoring coastal water quality along the east coast of India, funded by Ministry of Earth Sciences, Govt. of India
- Aerosol radiative forcing in India: Characterization of aerosol at Bhubaneswar, funded by ISRO, Thiruvananthapuram
- Study of carbon dynamics in estuaries & near shore waters of Dhamra & Mahanadi, funded by NRSC, Hyderabad
- Development of house hold defluoridation unit for safe drinking water, funded by DST, New Delhi
- Environmental pollution monitoring at Paradip port, funded by Paradip Port Trust
- Collection, Characterization & Screening of Microalgae & Pilot Scale Demonstration, funded by DBT, New Delhi
- Bioleaching of low grade Charcopyrite of Malanjkhand, funded by HCL
- Online City Air Pollution Monitoring with Moving Node in GSM Network , funded by DeitY, New Delhi
- Commercial process for manufacture of > 70% content pond ash bricks and blocks, funded by BMTPC, New Delhi

Director, CSIR-Institute of Minerals & Materials Technology, Bhubaneswar – 751013
Phone: 0674-2379401; Email: dir@immt.res.in; URL: www.immt.res.in

OUR **FACILITIES**

- NABL accreditation for Chemical and Biological Laboratories
- Bioremediation Laboratory
- Algal Raceway pond
- Herbarium
- Pilot plant facility for manufacture of building bricks using industrial wastes
- DNA nanotechnology Laboratory
- Cell culture facility
- Mineral bio-processing

TECHNOLOGY & SERVICES

- Green technology for application of Fly ash, red mud and other industrial and mining wastes in construction of bricks & cement free concrete roads
- Process for treatment of chrome chemical waste residue for in-situ stabilization of leachable Cr^{+6} into non-leachable Cr^{+3} and its further utilization as building material aggregate
- Process for insitu-stabilization of Pb and Zn in jarosite and making value added building materials.
- Process for the Preparation of High Purity Magnesia from Marine Bittern
- Process for recovery of copper from Lean sulphide/chalcopyrite ore by bio-heap leaching technology.
- Innovative constructed wetlands based wastewater treatment plant
- Bioremediation of Hexavalent Chromium through Plant Microbe interaction
- Atmospheric pollution monitoring and assessment
- Potash enriched biochar from waste biomass
- Environmental Impact Assessment
- Water Quality Testing

OUR **PARTNERS**

ISRO

imfa

OMC

vedanta

JINDAL STEEL & POWER

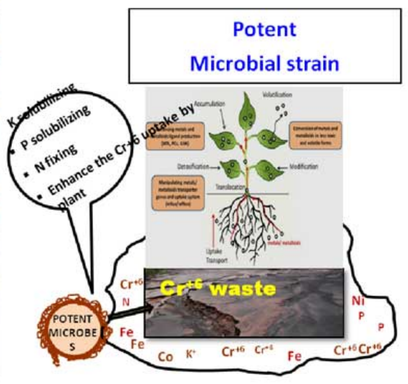
PARADIP PORT TRUST

HINDUSTAN COPPER LIMITED (A Government of India Enterprise)

ODISHA Odisha State Pollution Control Board

NTPC

RECLAMATION AT OMC MINES



TREATMENT OF HEXAVALENT CHROME CONTAMINATED WASTE

Cr+6 1000mg/kg

Sintering set up

Pelletizer

Cr+6 0.02 mg/kg

Treated Residue

PROCESS MODELLING & INSTRUMENTATION

Modelling, Simulating & Optimizing the Performance of Industrial Processes

CORE **EXPERTISE**

PROCESS MODELLING

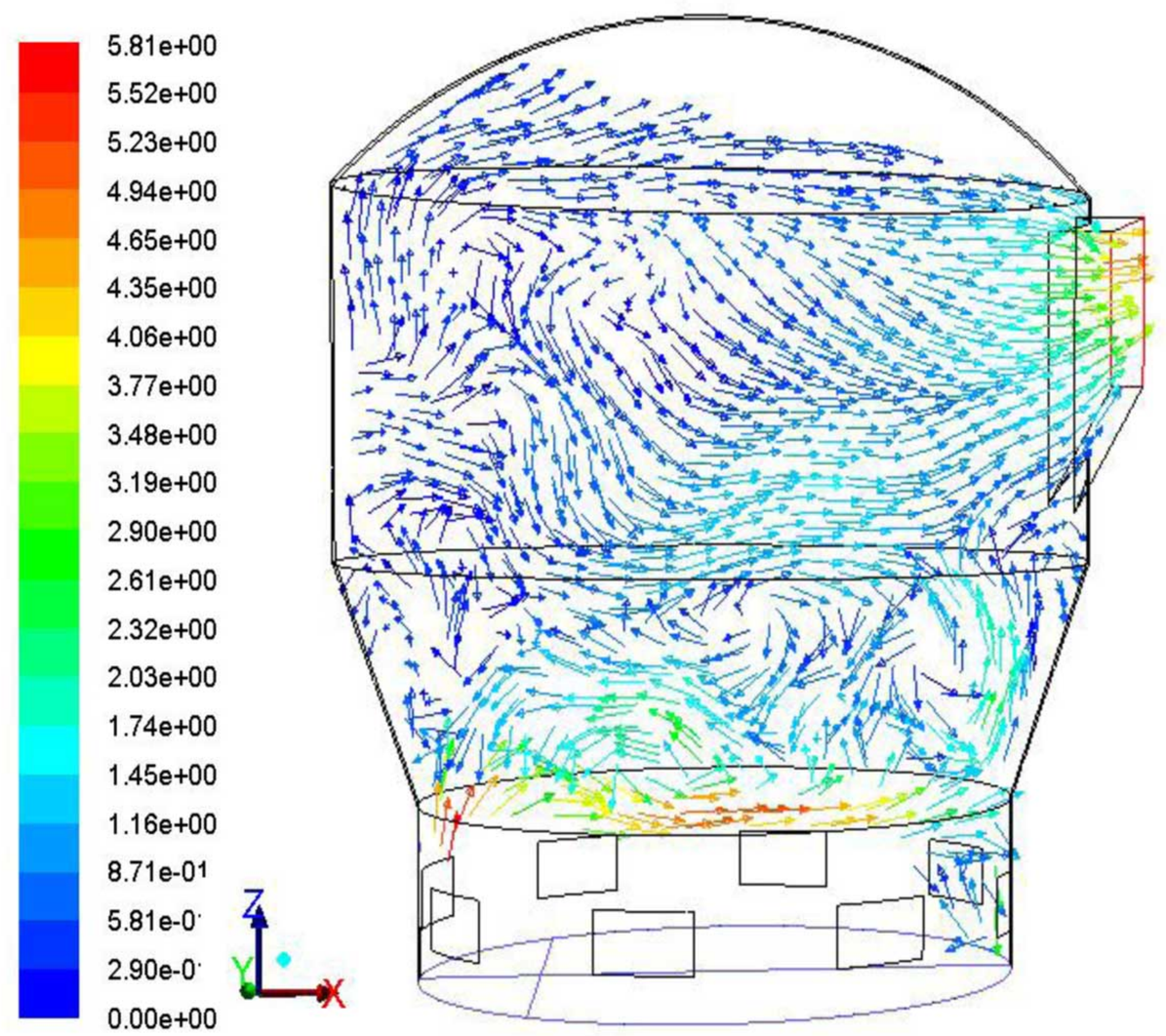
- Process modelling and simulation of chemical, mineral and metallurgical units
- Computational fluid dynamics
- Discrete element method
- Molecular modelling
- Artificial neural networks
- Data reconciliation
- Process optimization

INSTRUMENTATION

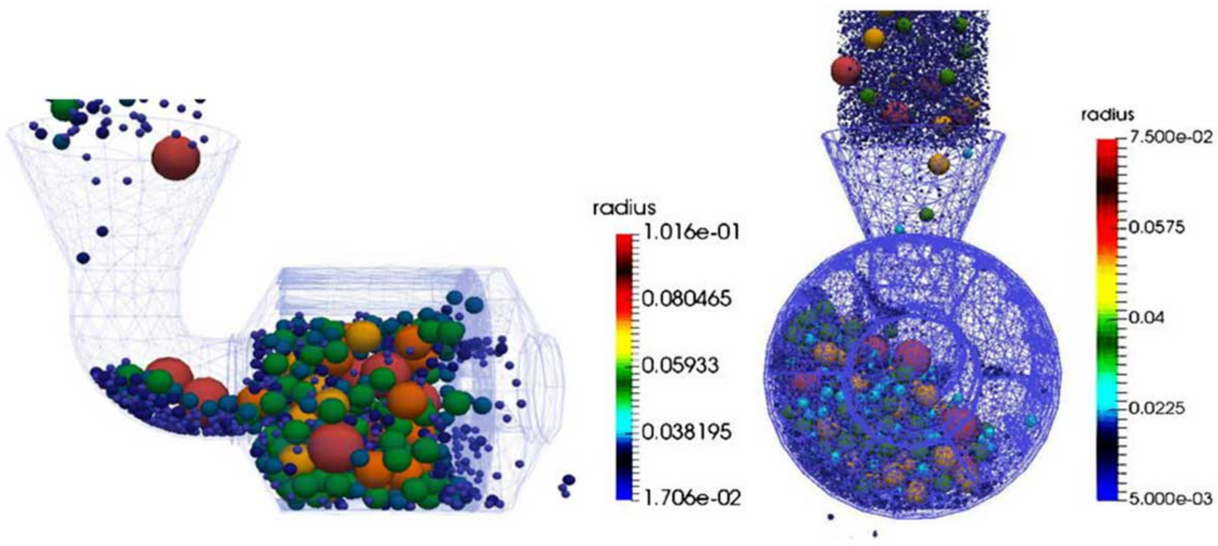
- Industrial Instrumentation
- Signal Processing
- Image processing
- Wireless Communication
- Embedded System
- PC based Instrumentation
- Electronic circuit design

RURAL TECHNOLOGY

- Design of energy efficient cook stoves and dryers



CFD simulation of a fluidized bed roaster



DEM simulation of SAG mill

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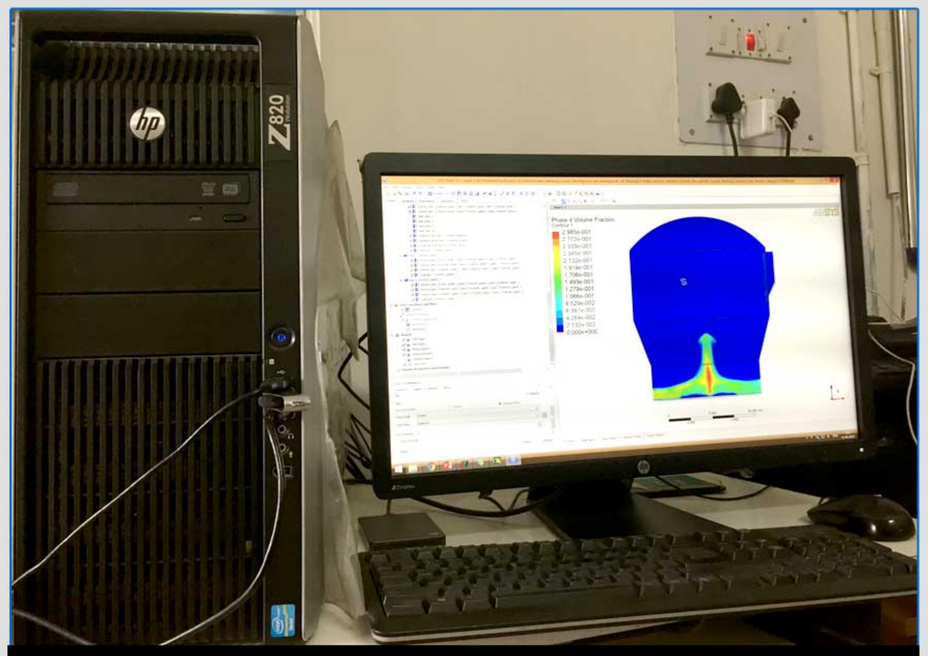
OUR **FACILITIES**

PROCESS MODELLING: High end workstations, ANSYS Fluent, COMSOL, Gaussian 09, Design Expert,STATISTICA, LIGGGHTS, OpenFoam, MATLAB

INSTRUMENTATION: Electronic circuit development facilities, PCB Design, dSpace system for Rapid prototyping and HIL simulation, LabVIEW and NI hardware for PC based and real-time system development, Embedded system design tools, MATLAB and signal/ image processing system, Sensors and signal conditioning device, Embedded vision system with various industrial camera, Wireless data acquisition system, Temperature measurement, Plasma spectroscopy

COOK STOVE TESTING CENTRE: MNRE approved centre for certifying chulha

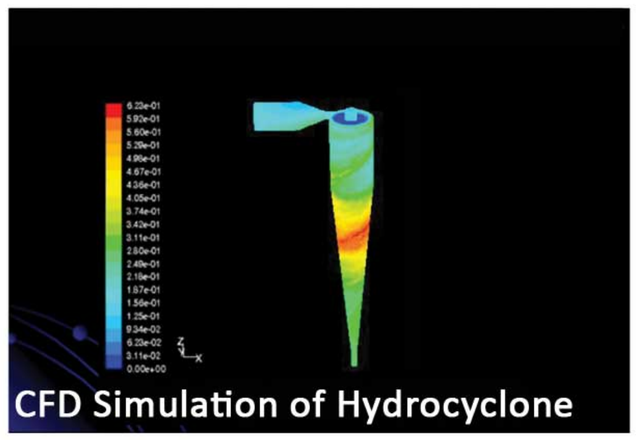


CFD Simulation facility

OUR **ACHIEVEMENTS**

- CFD modelling of an industrial scale fluidized bed roaster to improve the performance
- CFD based design of a microfluidic system for separation of charged metal nanoparticles by dielectrophoresis
- Modelling and simulation of multiple hearth furnace for reduction roasting of chromite overburden.
- ANN based design of a control system for controlling the interface level in a flotation column.
- Image processing based pellet size monitoring system
- Active noise control system
- Vibration based ball mill monitoring
- Wireless remote control system
- Improved environment friendly natural draft front fuel charged cook stoves for cooking of food in domestic as well as community sector.


Wireless Monitoring of Mill By Vibration Analysis


CFD Simulation of Hydrocyclone

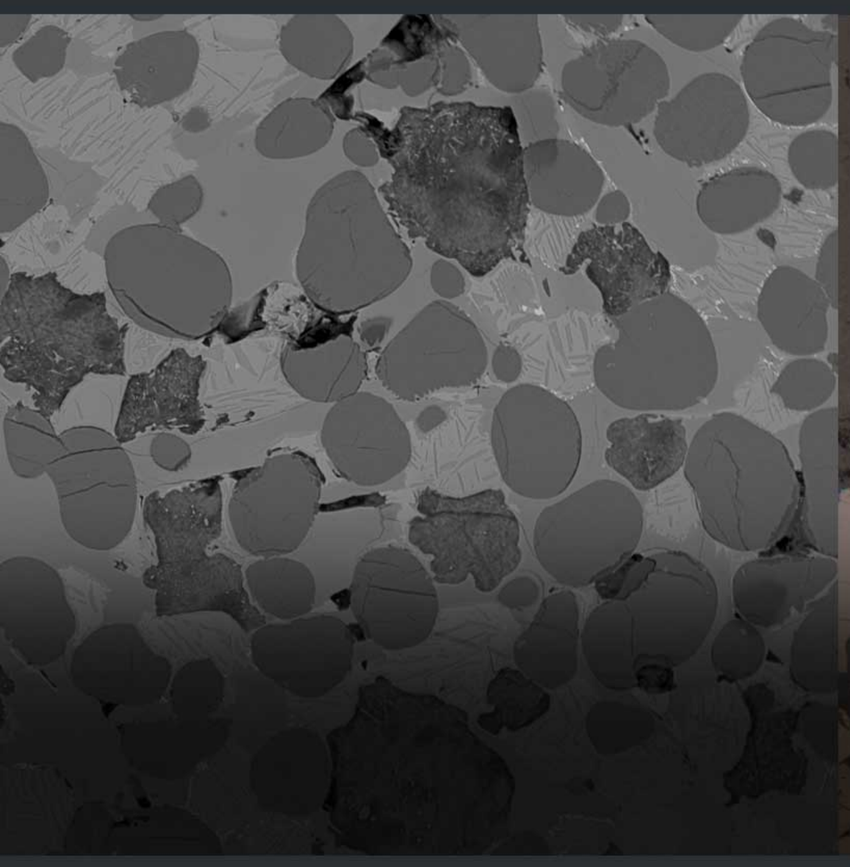

Improved natural draft biomass cook stoves

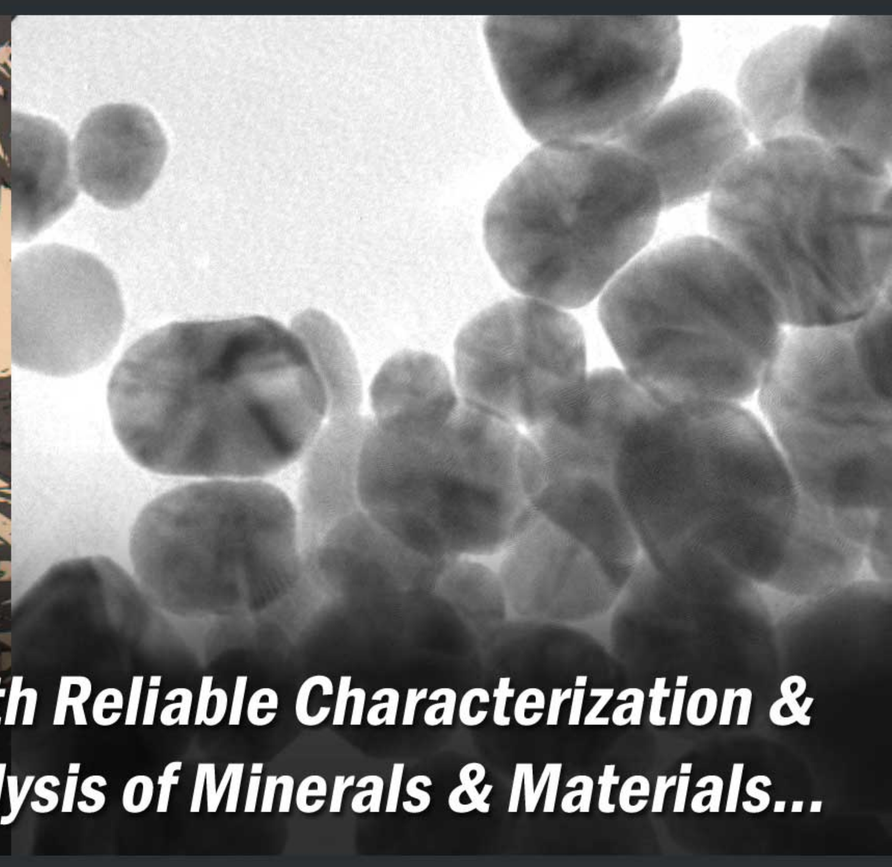
CURRENT **PROJECTS**

- Data Reconciliation for vanadium and zinc balance at a Alumina Refinery
- Design and development of stirred mills to efficiently treat lean-grade Indian ores
- Molecular modelling and CFD simulation of a hollow fiber membrane for extraction of metal ions
- Molecular modeling studies of low cost mineral based adsorbent : Implication to fluoride and uranyl ion
- Expert system development for pelletization process
- Development of industrial grade moisture meter
- IoT based monitoring of industrial processes
- Image processing based system development
- Design and development of improved biomass cook stoves and dryers

Industrial Trial of EYE-ON-PELLET at JSW

CENTRAL CHARACTERIZATION DEPARTMENT





Empowering R&D with Reliable Characterization & Analysis of Minerals & Materials...

CORE **EXPERTISE**

- Mineralogy, Ore Geology, Mineral & Ore Characterization, Coal Petrography
- Electronic structure of various materials (Transition metal oxides, Topological insulators etc.).
- Surface and interface study of thin films and multilayers.
- Photoemission spectroscopy (UPS & XPS), X-ray Absorption spectroscopy (XAS), Secondary ion mass spectroscopy (SIMS); Mass spectroscopy, Chemical imaging and Depth profiling etc.
- Synthesis of functional nanostructured hierarchical semiconductor materials by various kind of soft chemical approaches
- Applications towards photocatalysis and water splitting.
- Characterization & analysis of minerals and materials using Micro-Raman Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Transmission Electron Microscopy (TEM), X-ray diffractometry (XRD), Thermogravimetry-Differential Scanning Calorimetry (TGDSC), WD X-ray Florescence Spectroscopy (WDXRF), Scanning Electron Microscopy (SEM), Electron Probe Micro Analyzer (EPMA), Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), Atomic Absorption Spectroscopy (AAS) etc.

MAJOR **FACILITIES**

Transmission Electron Microscope (TEM)

X-Ray Diffractometer (XRD)

WD - X-Ray Fluorescence Spectrometer (WD-XRF)

Field Emission Scanning Electron Microscope (FESEM)

Raman Spectrometer

Electron Probe Micro Analyzer (EPMA)

Scanning Electron Microscope (SEM)

Fourier Transform Infrared Spectroscope (FTIR)

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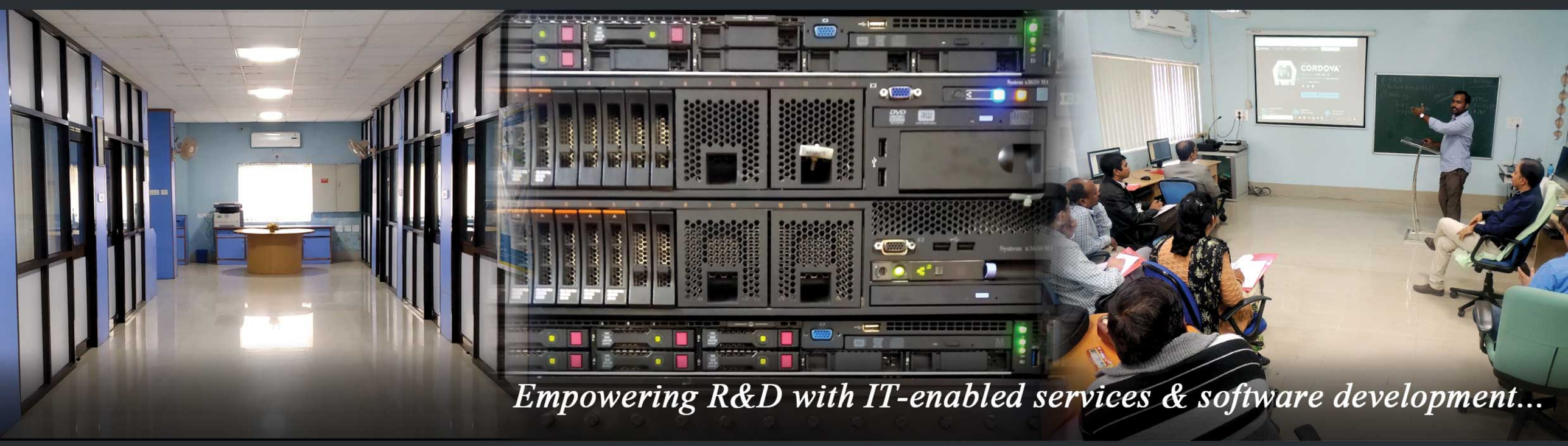
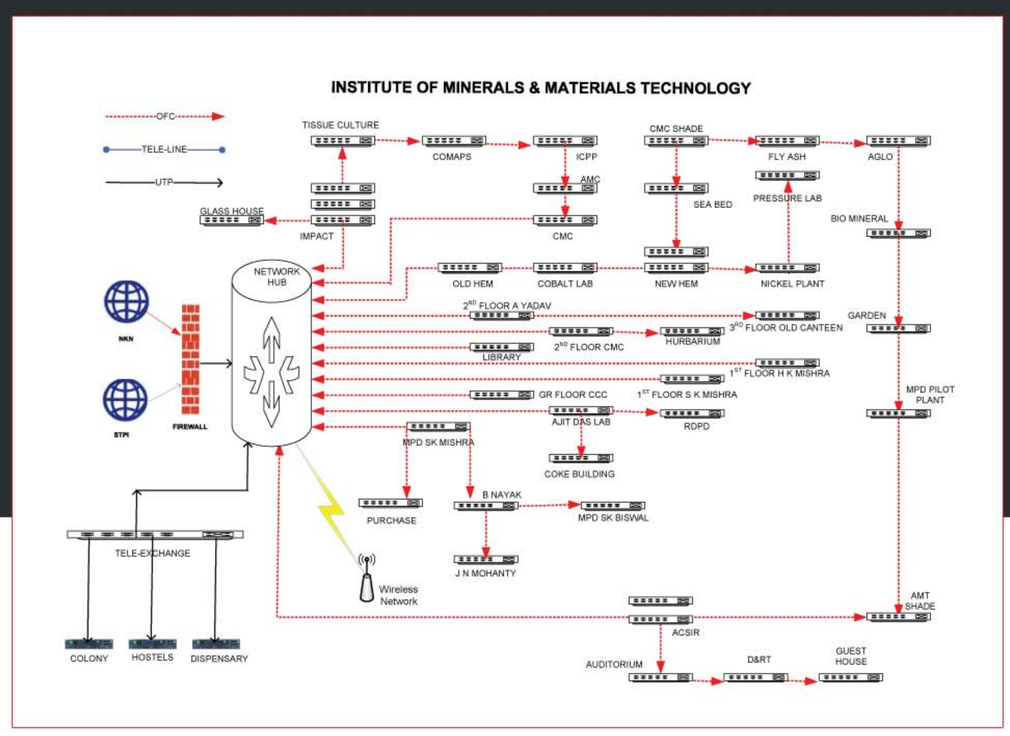
COMPUTER NETWORKING & e-MANAGEMENT



Empowering R&D with IT-enabled services & software development...

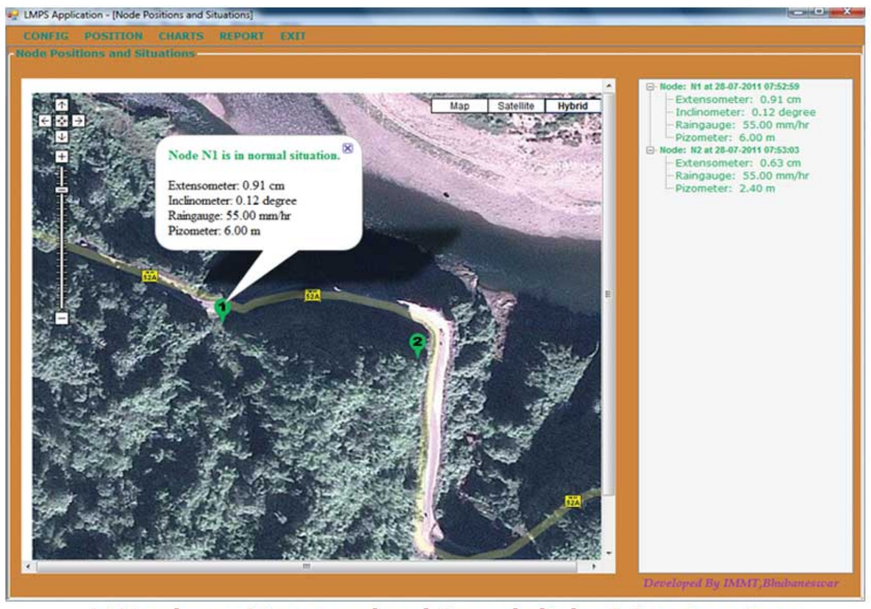
CORE **EXPERTISE**

- Implementation and maintenance of various IT services, hardware & software
- Application Software Development and Customization
- Decision Support Expert System
- Wireless Sensor Network
- Publication Support & Repository Services

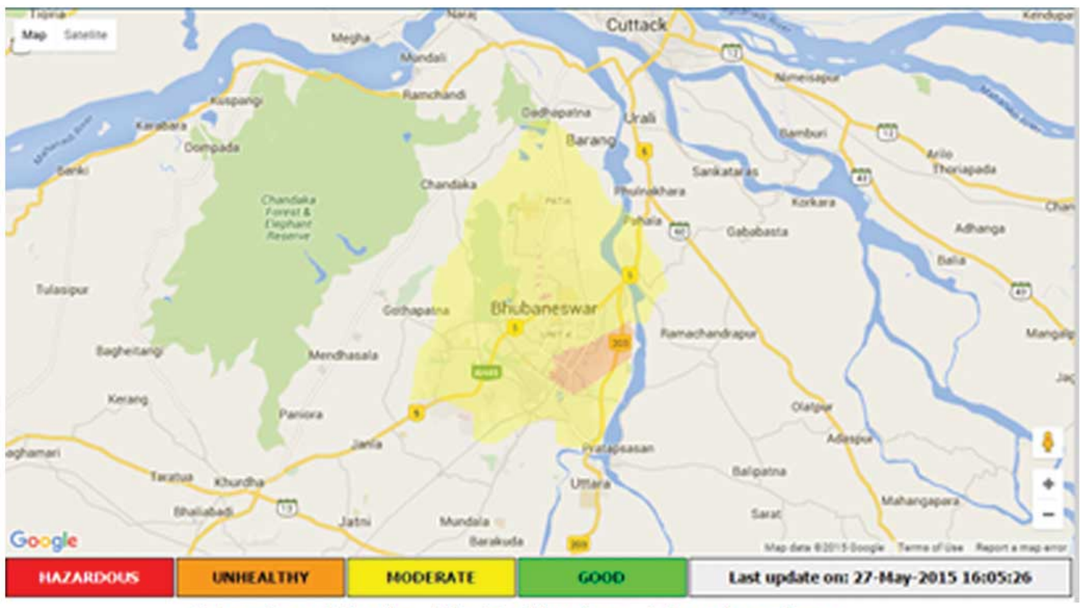


ACHIEVEMENTS

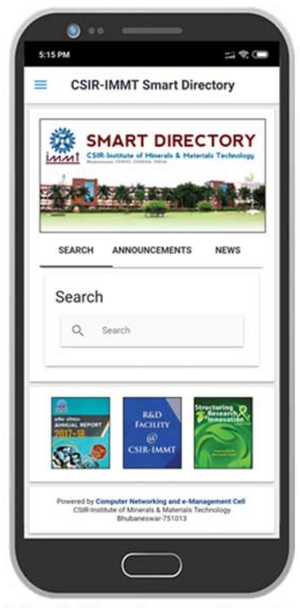
- Service & Maintainance of around 1300 No(s) of Servers, Computers & Peripherals and 160 No(s) of LAN equipments.
- Network powered with 2 No(s) of core switches & 50 No(s) L2 switches with over 1500 nodes.
- Maintainng a high bandwidth to the office & campus network with 100Mbps & 16Mbps using ISP(s) as NKN & SPTI respectively
- Development & Implementation of Online Repository of E-contents (ORE) with more than 2500 records
- Design, Print & Publication of various institutional contents since 2017
- Administration & management of ERP Application - OneCSIR
- All-in-One Intranet Services through web portal
- Mobile Application Development and Implementation
- Development and Implementation of Online City Air Pollution Monitoring & Prediction System
- GIS Based Application software for data Aggregation and Analysis



Wireless Networked Landslide Monitoring



Moving Node Air Pollution Monitoring



Mobile App. Dev.

PROJECTS ACCOMPLISHED

- Landslide Monitorring System using Wireless Sensor Network (Funded By DeitY, Govt. of India)
- Online City Air Pollution Monitoring with Moving Node in GSM Network

CNeM

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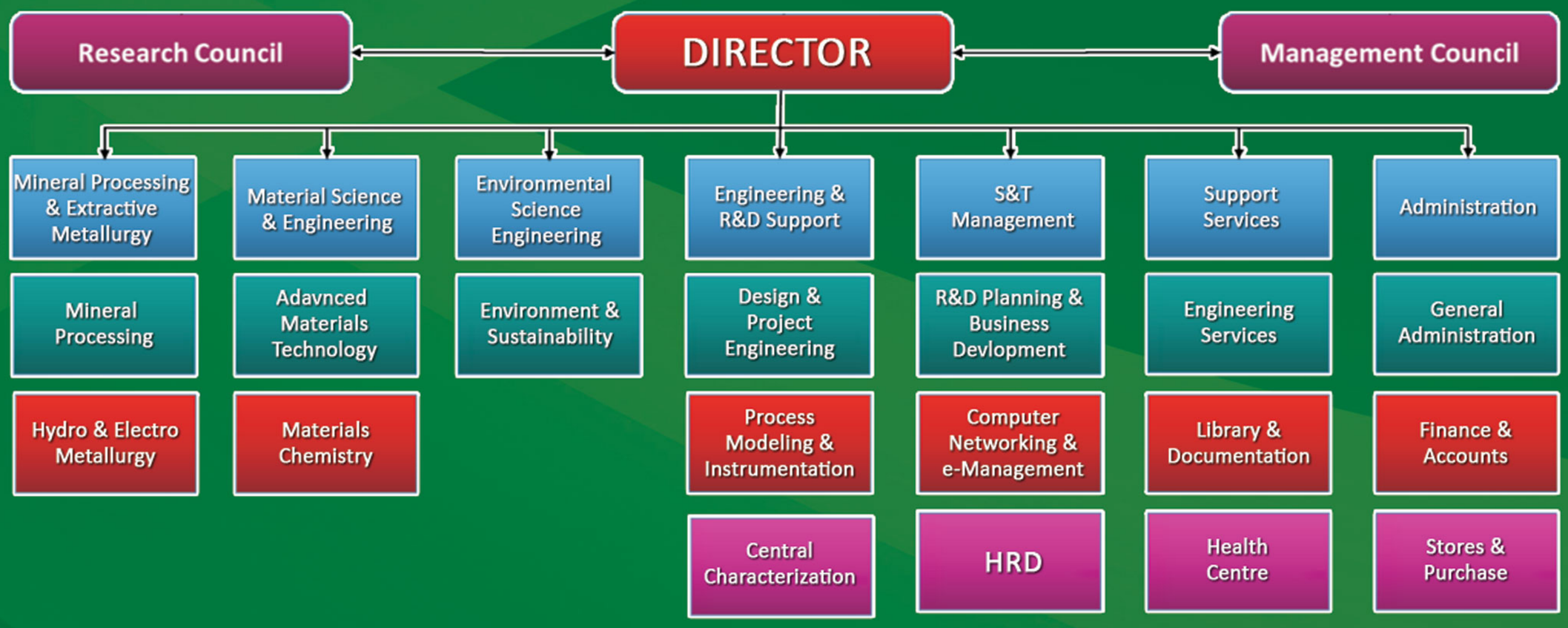
Vision

A world-class centre of "Knowledge & Innovation" for sustainable development of mineral & material resources

Mission

Develop globally competitive, innovative & sustainable mineral & material resource processing technology that delivers maximum socio-economic benefits.

Organizational Chart



Major Accomplishments

- Iron ore Beneficiation Technology
- Graphite Beneficiation
- Coal Beneficiation
- Bauxite Beneficiation
- Column Flotation Technology
- Nickel from Chromite Overburden
- Ni, Co, Cu from secondary sources
- TiO_2 from Ilmenite using Moving Bed Plasma
- Extraction of Te from Anode Slime of Cu Plant
- EPA & EIA studies of Coastal Odisha
- Terafil Water Filter, Smokeless Chulha
- Agro-implements

Contact Us @

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