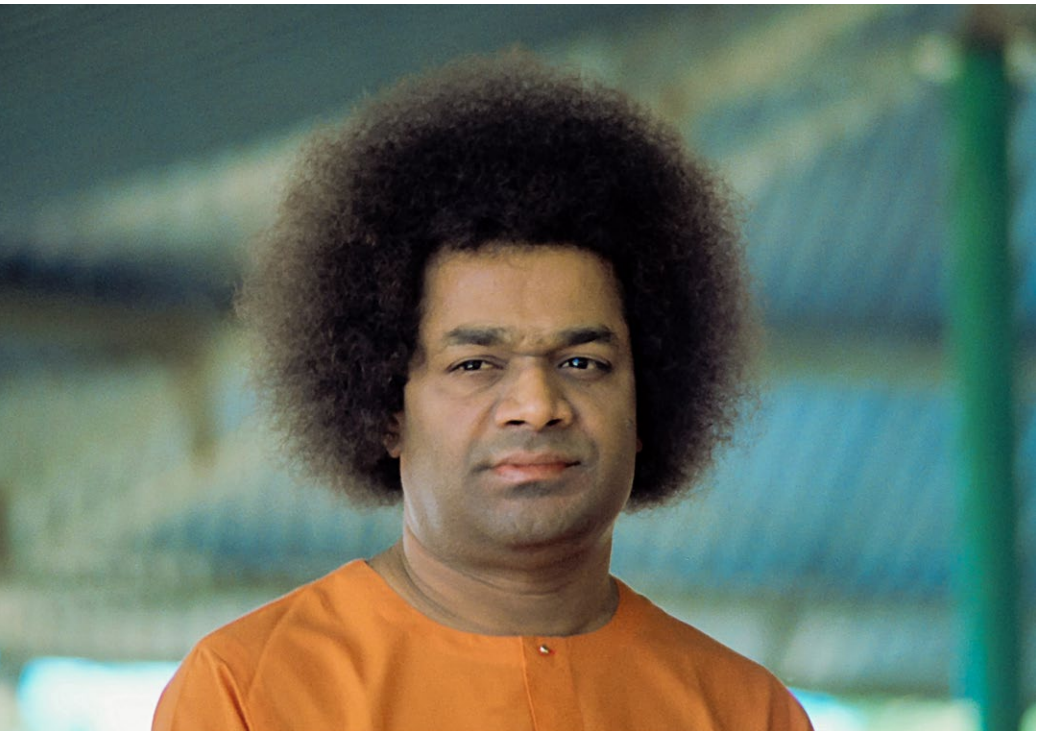
SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
PRASANTHI NILAYAM
सत्यं वद धर्मं चर

Central Research Instruments Facility

SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING



"In the field of science today, there is great emphasis on research and discovery. But, unless the results of research are applied in practice, it will be an expensive futility. If all the time is spent on research, when is it to find useful application in practice? Nor is there any sense of discrimination in the promotion of research...Those engaged in research seem to be more concerned about boosting their name and fame by their research than about promoting public well-being through the results of their research. Nor do they seem to be bothered about the harmful consequences of their discoveries...The scientific knowledge we acquire must be used for the benefit of our fellowmen."

Bhagawan Sri Sathya Sai Baba
Revered Founder Chancellor

THRUST AREAS OF RESEARCH

Sri Sathya Sai Institute of Higher Learning (SSSIHL) has identified thrust areas of research around which several research projects and studies are designed, cutting across traditional subject boundaries.

The research activities of faculty and students at SSSIHL envision exploration and promotion of socially relevant, rural-friendly, translational research encompassing three domains - Health, Environment and Energy, as elucidated below. This brochure details the research objectives, relating to aforementioned thrust areas, their outcomes and applications related to these three areas, along with the state-of-the-art infrastructural facilities that have been established to accomplish the well designed objectives encompassing the thrust areas..

HEALTH

ENVIRONMENT

ENERGY

HEALTH

Health-related research at SSSIHL may be sub-categorized into five specific topics:

- Understanding disease states
- Detection & Healing
- Medical Imaging
- Functional Materials
- Food & Nutritional Sciences

Understanding Disease states

The research work at the Department of Biosciences seeks to address the fundamental questions dealing with understanding a variety of diseases, their biomarkers and therapeutic targets.

Biomarkers & therapeutic targets

The focus here is on biological mechanisms that eventually lead to manifestation of different diseases. Multi-disciplinary and multi-faceted approaches — which include analysis of clinical data; biophysical, biochemical, molecular biology; imaging; cell culture models; metabolomics; genomics; proteomics; computational and animal models (Yeast and Mice) — are being used to answer crucial questions for understanding disease biology. Active research is being pursued to unravel the causes for Bone diseases

(Avascular necrosis of femoral head; Rheumatoid arthritis; brittle bone disease; Cerebral palsy); Eye diseases (Different types of glaucoma); Cardiovascular disease (Atherosclerosis); Neurological diseases (Demyelinating disease: Multiple sclerosis, Tumefective demyelinating leshion; Amyloid diseases: Huntington's, Parkinson's, Alzheimer's disease and Amylotopic Lateral Sclerosis).

Antibiotic Resistance

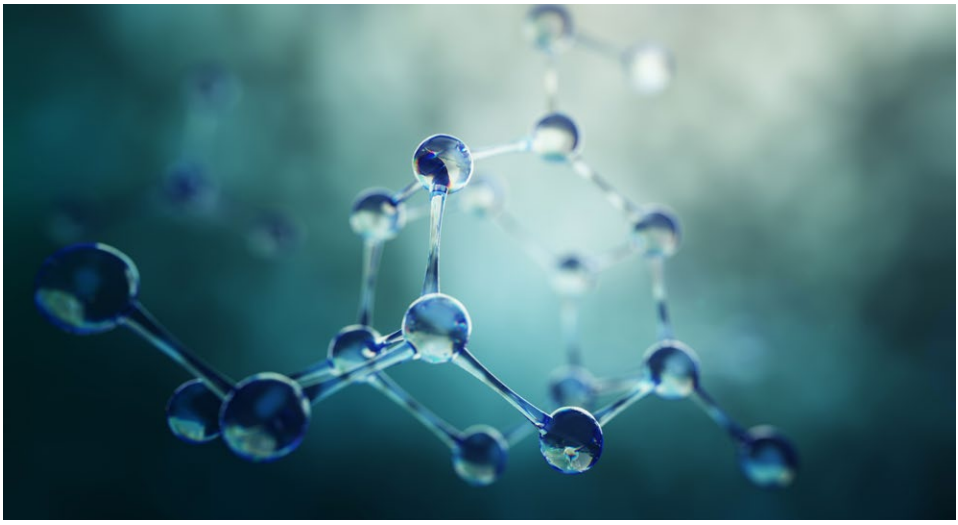
Another area of research focus of the faculty of Biosciences is Molecular epidemiology of clinically isolated multidrug resistant gram negative bacteria. They are actively involved in whole genome sequencing and analyses of clinically isolated pathogenic bacteria; bacterial outbreak analysis; molecular epidemiology; and prediction modelling of antibiotic resistance.

Detection and Healing

The faculty of the Department of Chemistry are tackling issues pertaining to the detection of disease states and their remedy.

Pharmaceutical derivatives

Semi-synthetic organic compounds from natural resources are being explored towards anti-cancer, anti-bacterial, anti-inflammatory and anti-fungal activities.



Bio-medical Sensors

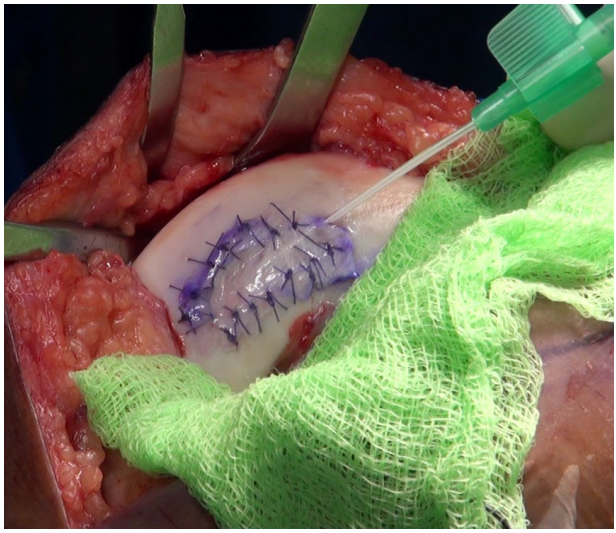
The development of bio-medical sensors is another promising area of research; it is expected to lead to the design and fabrication of indigenous, low-cost, mobile-Health sensors. Their research is directed towards exploitation of plasmonic nano-thin films as smart sensor chips in point-of-care diagnostic devices for real-time quantification of biomarkers of different disease states that include: perinatal depression, heart ailments, thyroid dysfunction, hyperbilirubinemia and vector borne diseases, such as dengue.

Alternative Therapy

The faculty at the Department of Chemistry are also exploring the effect of alternative medicines on clinical depression. Their research involves the use of vibrionics medication, targeted muscle relaxation therapies and sound therapy towards prevention and treatment of perinatal depression in patients.

Autologous Chondrocyte Implantation

The faculty at the Department of Biosciences work on regenerative medicine and tissue engineering, where they repair and regenerate the human knee cartilage. They have established an Autologous Chondrocyte Implantation (ACI) technique at SSSIHL. In this procedure, chondrocytes are extracted from a knee cartilage biopsy and cultured ex vivo in autologous serum.



Medical Imaging

The Department of Physics focuses on research and development of medical imaging systems.

Nuclear Medicine Imaging

Nuclear Imaging modality supplements and complements the existing radiological imaging techniques such as X-Ray, CT, MRI, and PET. The Gamma Camera Imaging system developed by the faculty at the Department of Physics can be used for diagnosing the abnormalities in Heart, Kidneys, Thyroid, Bone hot spots, using novel Cadmium Zinc Telluride (CZT) technology.

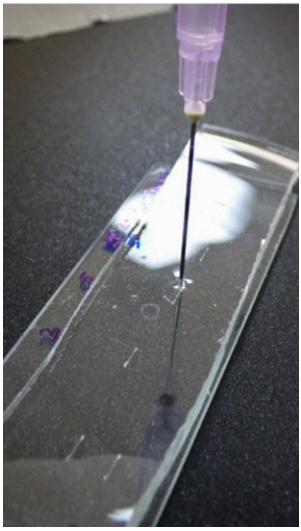
Optical Coherence Tomography

The faculty at the Department of Physics are working on the optical frequency comb spectroscopy and optical coherence tomography-based devices for middle-ear (Otitis Media) diagnosis.

Functional Materials

Micro-Nano machining

Faculty at the Department of Physics are involved in fabricating micro-nano channels and substrates using the state-of-the-art femto second laser micromachining. The same



group utilizes this technology to develop lab-on-chip opto-fluidic device prototypes for fluorescence-based detection and micro-electroporation of cells.

The faculty are also addressing key issues pertaining to the functional materials to be employed for energy harvesting and storage, photonic, piezoelectric, thermoelectric and biomedical applications.

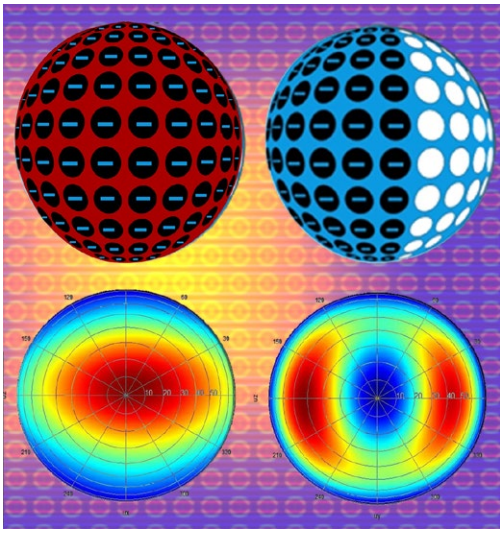
Investigations into the conversion of waste-to-wealth (such as rice husk and ground nut shells to solar grade silicon, bio-waste to bio-compatible machinable ceramics, etc.), functional materials for a variety of applications that include energy harvesting, prosthetics, space, electrical and electronic engineering, strategic and defense, automotive, green building technologies, etc. are being carried out.

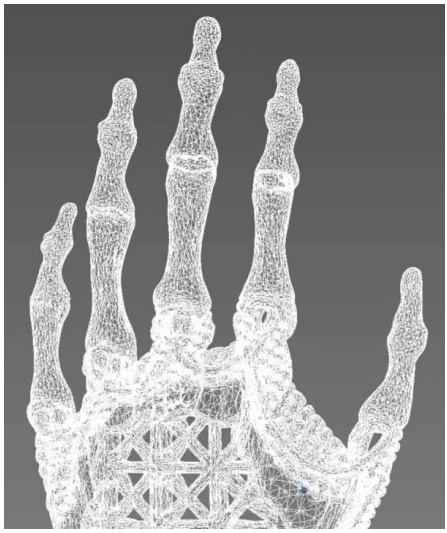
Plasmonic Nanomaterials

Faculty at the Department of Chemistry focus on the synthesis of various nanomaterials and composites of colloids for applications in plasmon-enhanced spectroscopy, sensors and drug delivery.

Bio-materials

A group of researchers at the Department of Chemistry is associating with the design and development of multifunctional materials and composites as bone cement and bone glue. Computational techniques for optimizing bone regeneration parameters and properties of Hydroxyapatite composites are being used for this purpose.





Food and Nutritional Sciences

The faculty at the Department of Food and Nutritional Sciences focus on research pertaining to three major areas of macronutrient malnutrition, micronutrient malnutrition and chronic lifestyle diseases. The various approaches of research include **food metabolomics** which comprises profiling of nutrients and health promoting compounds in novel and indigenous food crops such as culinary and herbal microgreens; medicinal pigmented rice varieties; spices; mushrooms; and sprouts. The research work on **nutritional biology and metabolomics** involves assessing correlation of diet and human health/disease; and micronutrient bioavailability. **Food fortification** studies include formulation of ready -to-use supplementary foods and mineral fortified foods. Yet another interesting area of research is the development of **functional and therapeutic foods** for special clinical conditions and chronic diseases.

Environment friendly bio based edible coatings have been developed to **extend shelf life and minimize postharvest loss** of various fruits and vegetables such as papaya and tomatoes. Studies on utilization of by products and waste from fruit industries as sources of bioactive compounds and bio colours is a recent area of research focus of the department of Food and Nutritional Sciences.

Processing of foods using osmotic dehydration and solar drying methods are being explored as avenues for technology transfer to rural women entrepreneurs in the department of Food and Nutritional Sciences.

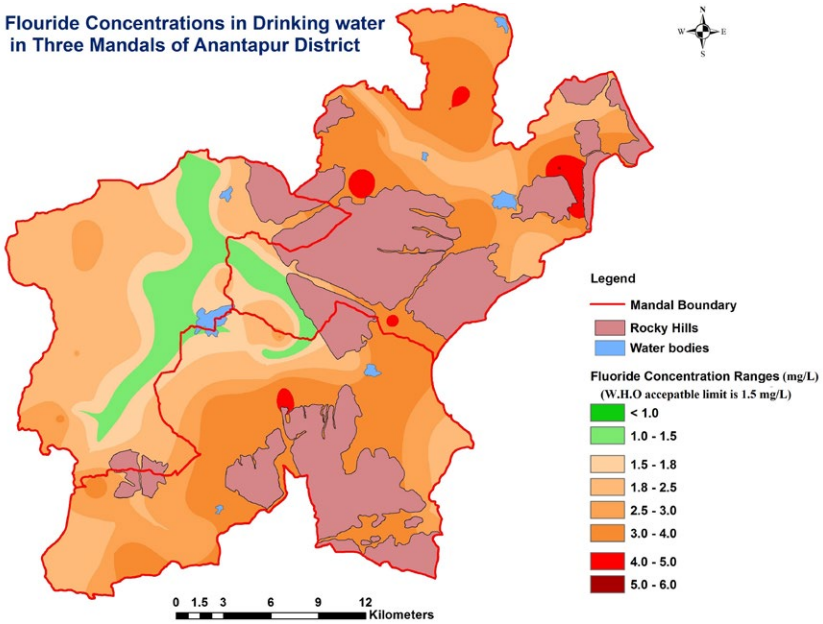
To address 'hidden hunger' (micronutrient malnutrition), a major nutritional concern in India caused by the deficiency of essential vitamins and minerals, the Department of Food & Nutritional Sciences explores the use of varieties of **tropical micro-greens** that have higher nutritional value than mature vegetables.

ENVIRONMENT

Environment related research at SSSIHL is mainly focused on water quality monitoring, treatment and integrated water shed management.

Water Quality Monitoring

The Department of Chemistry has taken up the task of assessing the water quality of three mandals in the district of Anantapur, Andhra Pradesh — Kothacheruvu, Bukkapatnam and Puttaparthi — covering 75 villages. The focus here is on understanding the quality of water resources through effective water quality assessment tools. Physico-chemical parameters have been profiled, covering the relevant anions and cations along with pH, total hardness, total alkalinity, conductivity and total dissolved salts. The current tools being employed for water quality assessment include: Geospatial Information System based spatio-temporal study; Multivariate statistical tools for water quality determination; and Hill-piper plots to estimate the Geogenic exposure of ground water. These tools are employed for integrated water shed management by identifying aquifers, reservoirs and drains.



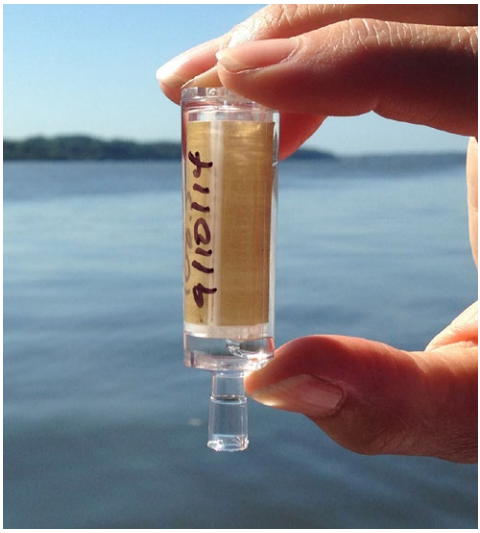
Water Purification

Defluoridation

The ground water in Anantapur district, Andhra Pradesh is known to have high-level fluoride content besides the other contaminants. Almost 90% of villages in the three mandals, viz. Kothacheruvu, Bukkapatnam and Puttaparthi contain fluoride content beyond the permissible limit. This results in numerous health problems that include skeletal and dental fluorosis. The researchers at the Department of Chemistry have taken up the design and development of defluoridation techniques using agro waste products.

Removal of Toxic pollutants

Heavy metal ions and drugs/pesticides pollute the drinking water in many parts of India. The Departments of Chemistry and Biosciences jointly work on the purification of water from such pollutants. They use specially engineered materials with high adsorption capabilities towards these pollutants. So far they have engineered high-surface nanomaterials for purification of water. They also employ microbial fuel cells for wastewater treatment and metal recovery by bio-electrocatalysis.



ENERGY

India is currently the sixth largest consumer of energy in the world and its energy demand is growing at an alarming rate. This necessitates a concerted effort to broaden our energy resources and at the same time a reduction in our energy consumption.

Fuel Cells

Faculty at the Department of Biosciences pursue research on microbial fuel cells (MFCs) to harness electrons from bacterial oxidation of substrates. This technique has the potential to address two of the major sustainability issues that confront the globe, viz. wastewater treatment and production of clean energy. Their attempts have been successful in developing novel multi-chambered MFCs and use of carbon dots to enhance its performance.

Thermo-Electric Materials

Half-Heusler thermoelectric materials have attracted extensive research interest over the last two decades owing to their thermal stability, mechanical strength, and moderate efficiency. Three new compounds (HfRhBi, ZrIrBi and ZrRhBi) have been recently found to be stable and have narrow to moderate band gaps. The faculty at the Department of Physics aim at synthesizing these compounds both in the form of nano-powders and thin-films and study them for their thermoelectric applications.

Perovskite Solar Cells

The development of low-cost Perovskite solar cells is being attempted at the Department of Physics. These cells are highly efficient and stable with low processing cost. The focus here has been to improve this technology with innovative flexible, transparent or all-perovskite tandem cell modules by overcoming the limitations of lead toxicity and increased durability.

Super Capacitors

For the development of next generation supercapacitors, Faculty at the Department of Chemistry aim at the synthesis of high surface-area activated carbons from mushrooms, spent mushroom substrates and nano-metal oxide decorated carbon composites.

Piezo-electric Materials for Energy Harvesting

The faculty at the Department of Physics are into the development of energy harvesting devices for ubiquitously harvesting mechanical energies that are dissipated both by men and machines. They are involved in fabricating hybrid piezoelectric and triboelectric

devices that could be used to power minor electronic portable devices. The materials for piezoelectric based sensors and actuators are being developed for strategic, space and automotive applications.

Green Building Technologies

Energy efficient materials associated with low thermal conductivities are being synthesized for civil engineering applications. The researchers at both the Physics and Chemistry departments are in the process of developing functional materials for infrared (IR) reflectance coating applications. These coatings on glass panes and roof tops are expected to reflect IR part of the electromagnetic spectrum which in turn provide thermal comfort within the building by maintaining a temperature that would be 5-10^{0}C less than that of the ambient temperature.

SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
CENTRAL RESEARCH INSTRUMENTS FACILITY (CRIF)

GENESIS

The research areas and the associated objectives that are illustrated in the preceding sections are being addressed by the members of faculty across various science departments of SSSIHL. Though the research work in different disciplines/ areas that is being carried out has been satisfactory, it was unanimously felt by the scientific community at SSSIHL, that the research work can be accelerated, if the existing basic infrastructural facilities (scattered around) are embraced and strengthened by providing state-of-the-art infrastructural facilities under a single roof. This overarching vision has been realized with the kind support extended by the Sri Sathya Sai Central Trust.

In line with this vision, SSSIHL CRIF has been created with the objective of providing the latest and advanced characterization/analytical tools to carry out translational research in various areas of Science and Technology as detailed in the preceding sections. These in essence, include physical, biological, chemical, materials science, food and also computational and interdisciplinary areas.

SSSIHL CRIF also houses a complement of specialized research facilities housing several sophisticated state-of-the-art instruments in the areas of disease biology and plasmonics. This would enable our researchers to keep pace with the scientific developments taking place globally; and to publish their research findings in peer reviewed high impact journals; and through their concerted efforts to carry out research in cutting edge areas of Science and Technology and contribute to the needs of the society at large.

This facility is being used extensively by postgraduate and doctoral students as well as by faculty members across all the campuses of SSSIHL. Full-time technical assistants with specific expertise operate and maintain the instruments.

The facility is further supported through a constituted body of dynamic faculty members as instruments in-charge and full-time Research Associates assist in meeting the intended research objectives at the Centre.

The following core facilities are shared resources offering a range of services to the research community at SSSIHL. Indeed, these will further strengthen, expand inter- and intra-university research collaborative capabilities of our faculty.

SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
CENTRAL RESEARCH INSTRUMENTS FACILITY (CRIF)

FACILITIES

LEVEL G

GA: Femto Fab Facility

BlueCut Femtosecond Laser
Aerotech Air-bearing 3D sample translation stage

GB: Electron Microscope Facilities

Transmission Electron Microscope
Scanning Electron Microscope

GC: Offices and Ideation Room

LEVEL 1

1A: NMR & Mass Spectrometry Facilities

Nuclear Magnetic Resonance (NMR) Spectrometer
Liquid Chromatography Mass Spectrometer
Gas Chromatography Mass Spectrometer

1B: Materials Characterization Facility

X-Ray Diffractometer
Vibrating Sample Magnetometer

1C: Thermal and Optical Characterization Facilities

Thermogravimetric Analyzer
Differential Scanning Calorimeter
Dynamic Light Scattering (DLS) Particle Analyzer
Dilatometer
DTA
Cary Eclipse Fluorescence Spectrophotometer
Cary 630 FTIR Spectrometer
Cary 60 UV-Vis Spectrophotometer
Microwave Plasma Atomic Emission Spectroscopy
UV/Vis/NIR Spectrophotometer
Brunauer-Emmett-Teller (BET) Surface Area Analyser

LEVEL 2

2A: Wet Chemistry Laboratories

2B: Functional Materials Laboratory

- d33 meter
- LCR meter
- Impedance Analyzer
- PE Loop Tracer
- B-H Loop Tracer
- DC/RF Sputtering Unit
- High Temperature Furnaces
- Solar Simulator and Cell Tester

2C: Water Research and Electrochemistry

- Electrochemistry Laboratory
- Electrochemical Workstation

LEVEL 3

3A: Bio-Safety Laboratories: Level 1 and Level 2

- BB 150 CO_2 Incubator
- Real Time PCR System
- Incubated/Refrigerated Stackable Shakers
- Biological Safety Cabinet
- Heraeus Megafuge 8R Centrifuge
- NanoDrop 2000C Spectrophotometer
- Multimode Microplate Reader

3B: Functional Glasses and Ceramics Laboratory

- High Temperature Furnaces
- High Temperature Glass Fabrication Facility
- Muffle Furnace
- Tubular Furnace
- Glass Annealing Furnace (Delta Power Controls)
- Tubular Furnace (Delta Power Controls)
- Electrical Polling Unit
- Single Crystal Puller (Czochralski technique)

3B: Non-linear Optics Laboratory

Ferroelectric/Converse Piezoelectric Tester
Piezoelectric test-bench
Pyroelectric set-up (Chynoweth technique)
Electro-optic test-bench
Non-linear optical coefficients measuring set-up
Low temperature Raman and Photoluminescence Spectrocopy
Channel Spectrum Method (Birefringence measurements)
Refractive index measuring set-up

3B: Liquid Nitrogen Facility

3C: Central Utilities Facility

Ultra-Low Temperature Freezers
Cryogenic Storage Chest Freezers

LEVEL 4

4A: Computational Science and Plasmonics

Center for Computational Science & Molecular Modeling Simulation
Computational Materials Science

4A: Plasmonics Laboratory

4B: Institute Industry Interface Cell (IIIC)

4C: Optical Imaging and Integration

Raman Microscope system with Chemical Mapping Functionalities and Optical Microcopes (Fiber Optic Gyroscopes and Multi-modal Microscope)

LEVEL 5

Visiting Scientists' Suites and Meditation Hall

GA: FEMTO FAB FACILITY

Fab ULLAS – Ultrafast Laser Laboratory for Applied Spectroscopy and Fabrication

BlueCut Femtosecond Laser (Menlo Systems Germany)

Features

» Wavelength 1030 nm / 515 nm
» Pulse Energy: >10 µJ
» Average Power >10 W
» Pulse Duration: < 400 fs
» Burst Mode
» Single shot to 10 MHz

Aerotech Air-bearing 3D sample translation stage (ABL 1000 Air-Bearing Direct Drive Linear Stage; Motion Control Aerotech. Inc., USA)

Features

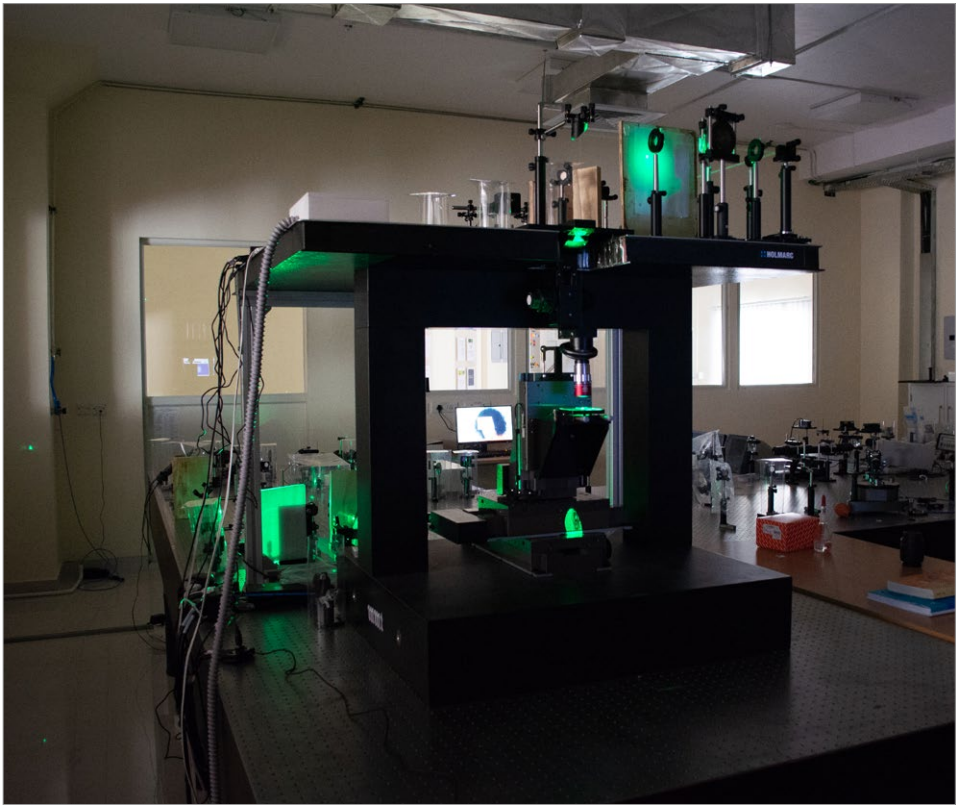
» For high-performance photonics alignment and assembly
» Linear encoder feedback provides up to 2 nm resolution
» Fully-preloaded air bearing
» Complete non-contact design
» Ultra-smooth velocity control (max. speed: 300 mm per sec)

Capabilities

» Micro/Nano Material Processing: Waveguide Writing, microfluidic channels, Optofluidic devices, integrated optical devices
» Spectroscopic characterization: Time-resolved, spectroscopic characterization of materials
» Laser Matter Interaction: Understanding basic science and phenomenon associated with intense laser light interaction with matter

The Femstosecond Laser micromachining facility is a powerful micro/nano fabrication tool for miniaturization of device size. The inherent 3D capability of Femtosecond laser micromachining helps to integrate microfluidic and optofluidc functions onto a single chip; thereby it enables fabrication of Lab-on-chip devices for point of care diagnostics. Integrated optical devices like opto-electronic resonator based sensors can be developed using this facility. Laser writing and direct printing of electrical circuits can be accomplished; submicron ablation in the area of interest adds nuances to printed organic and molecular micro-electronics. Micro & Nano scale structuring of surfaces is also possible for application in SERS and photovoltaics.


MenloSystems
BLUECUT



GB: ELECTRON MICROSCOPE FACILITIES

Transmission Electron Microscope (JEOL HRTEM JEM-2100 Plus)

Features

- Electron source: LaB_6
- High-Resolution Pole Piece
- Line resolution: 0.14 nm
- Point resolution: 0.23 nm
- Magnification: 50x to 15,00,000x
- Accelerating Voltage: 80 kV - 200 kV
- Camera: Bottom Mounted Olympus Tengra 5.3 MP CCD Camera system
- Modes: TEM, EDS, NBD and CBD
- Tilt range: X/Y : ±35 / ±30 degree

Capabilities

- Analysis of dry thin samples
- Micro structure analysis
- Structural Studies
- Chemical analysis

Transmission Electron Microscope (TEM) allows the researcher to obtain images of thin slices or nano particles of a variety of samples with resolution down to few nm. Lattice images and the defects associated with the samples could be analyzed along with crystal structures via electron diffraction analysis.

Scanning Electron Microscope (JSM-IT300 InTouchScope™)

Features

» Resolution: HV mode - 3nm (30 kV)
15 nm (1.0 kV)
» Resolution: LV mode - 4nm (30 kV BED)
» Magnification: 5x to 3,00,000x
» Accelerating voltage: 0.3-30 kV
» Inbuilt Detectors: SE & BSE
» Multiple ports for analytical attachments such as EDAX
» Specimen stage 5-axis motor stage
X: 125mm Y:100mm Z:5-80mm T: 10-90° R:360°

Capabilities

» High resolution imaging and high spatial-resolution analysis
» High throughout microanalysis using touch panel operation and the high speed stage
» Accommodates various sizes and types of specimens for extended observation and analysis

It is a tool to visualize the surface of solid samples with a resolution that can approach a few nm. Energy dispersive X-ray analysis could be used to analyze the chemical composition of a sample ~1µm region. Crystallographic orientation and structure could be examined using electron backscatter diffraction analysis. Microstructural features of a variety of materials that include metals, ceramics, biological, organic, etc. can be obtained.

1A: NMR & MASS SPECTROMETRY FACILITIES

Nuclear Magnetic Resonance (NMR) Spectrometer (Bruker Ascend 400 MHz)

Features

- UltraShieldTM Plus 9.4T magnet
- 5 mm BBFOPLUS probe
- Control temperature unit (from -50°C to 50°C).

Capabilities

- Structure verification and elucidation
- Molecular mobility: determination of conformation in solution
- Determination of enantiomeric excess
- Kinetic and temperature studies of reaction mixtures

This facility could be used to probe materials and biological processes at the molecular and nanoscale to obtain information on the 3D structures and dynamics of molecules. This instrument is used by chemists, materials scientists, biologists and clinicians. NMR spectrometry is used to study everything from DNA to disease–causing proteins. Information obtained from NMR studies aids in the development of new drugs. NMR Spectroscopy is used to study molecular conformation in solution, quantitative analysis of mixtures, determining the content and purity of a sample.

Liquid Chromatography Mass Spectrometer (LC/MS) (HR-MS [Q-TOF] and Triple quad)

SSSIHL-AGILENT Center of Excellence in Mass Spectrometry

Features

Liquid Chromatography

» Binary and quaternary UPLC systems.
» Nano-LC chip cube systems for low-flow proteomics
» Equipped with temperature controlled auto samplers
» Diode array detector

Agilent 6550 iFunnel QTOF

» Jet stream Dual ESI and APCI sources
» Extended Mass range: m/z 100-10,000
» Femtogram-level sensitivity
» Unbiased Metabolomics Platform

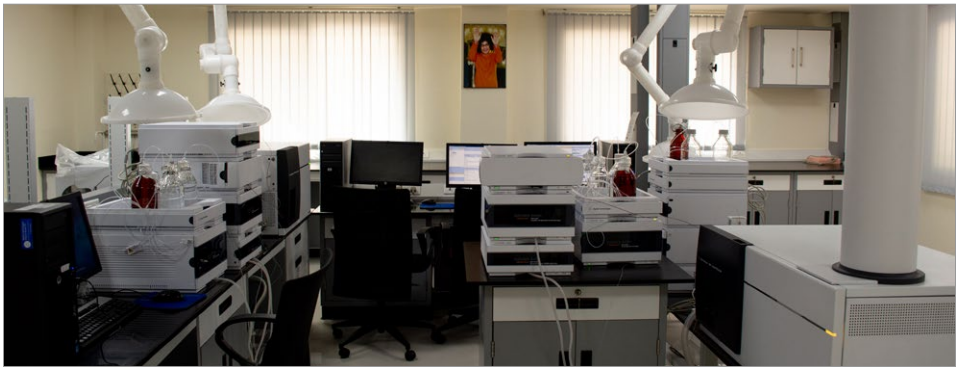
Agilent 6490 iFunnel MS/MS TripleQuad

» Jet stream Dual ESI and APCI sources
» Mass range: 5-1400 amu
» 500 MRMs per second, >40,000 MRMs possible in a method
» Targeted Metabolomics Platform

Capabilities

» Qualitative and Quantitative analyses in pharmaceutical, clinical, food safety, and environmental applications.
» Proteomics Analysis

Molecules can be identified based on their accurate mass. These equipment can be used to assess and quantify metabolites and proteins in patient samples, animal models, and cell culture (including plants & fungi). These facilities can also be used to identify and quantify transient changes which influence protein function, so as to elucidate the molecular mechanisms/ pathways at work.



Gas Chromatography Mass Spectrometer (GC/MS) - QP2010 SE

Features

- Mass range: m/z 1.5 to 1000
- Ionization mode: EI
- EI scan sensitivity: 1 pg octafluoronaphthalene 272 S/N > 200
- Pump: Turbo molecular pump (58 L/sec for He), Rotary pump 30 L/min (60Hz)
- Column flow: Up to 4mL/min

GC/MS is an instrumental technique, comprising a Gas Chromatograph (GC) coupled to a Mass Spectrometer (MS), by which complex mixtures of chemicals may be separated, identified and quantified. This makes it ideal for the analysis of hundreds of relatively low molecular weight compounds found in environmental materials. For compound to be analysed by GC/MS it must be sufficiently volatile and thermally stable.

In addition, functionalised compounds may require chemical modification (derivatization), prior to analysis, to eliminate undesirable adsorption effects that would otherwise affect the quality of the data obtained. Samples (such as soils, sediments, tissues etc.) to be analysed need to be solvent extracted and the extract is subjected to various 'wet chemical' techniques prior to GC/MS analysis.

It assists to identify and quantify various molecules that are volatile in nature. This instrument can be used in studies relating to fatty acids and pesticides present in Biological, Environmental and Food matrices.

It is a widely used technique in the analysis of perfumes and essential oils.

1B: MATERIALS CHARACTERIZATION FACILITIES

X-Ray Diffractometer (PANalytical Multifunctional X'PERT3 XRD)

Features

- Detector(s): PIXcel1D
- X-ray Source: Fully ceramic X-ray tubes manufactured by PANalytical
- 3 kW generator supporting all current and future X-ray tubes
- Goniometer Type: Vertical Goniometer (theta-theta) - DOPS goniometer

This equipment is generally employed to obtain structural information at atomic scale of plethora of materials including inorganic, organic and biological in different configurations. Indeed the structural studies can be carried out over a wide range of temperatures (RT to 1600^{0}C).

The X-ray data obtained could be used to obtain electron density and inherent spontaneous polarization of polar materials.

Capabilities

- Powder/Solid Samples Analysis
- BBHD – for excellent low angle performance, lower background, improved S/N ratio, higher intensity, excellent resolution, excellent for GIXRD, transmission geometry, SAXS, etc.
- GIXRD for thin film-samples
- Anton Paar – non ambient chamber for temperature range – RT to 1600^{0}C
- PIXcel Detector – high resolution detector with excellent sensitivity and dynamic range
- Rietveld analysis by HSP
- PAN ICSD database with multi-year license

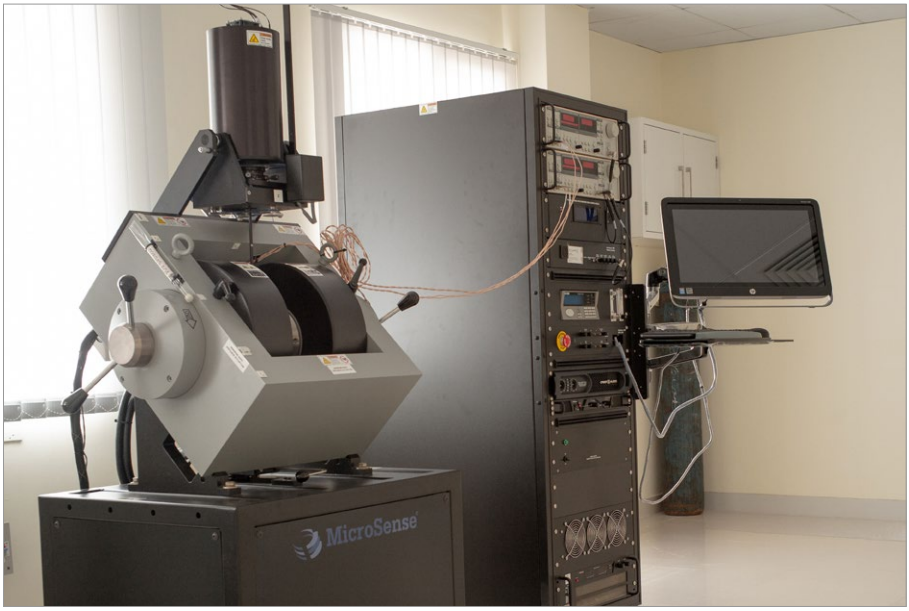
Vibrating Sample Magnetometer (VSM, EZ9 - Microsense)

Features

- Temperature range: 100K to 1000K
- Magneto Resistance option
- Vector coil option using dual signal processors
- Automatic Sample Rotation
- Sweep field option

Capabilities

Supports all types of magnetic measurements which include magnetic hysteresis and loops, IRM and DCD Remnance Loops, SFD, delta M, delta H and Henkel Plots, as well as Angular and AC Remnance Loops, Temperature scans and Time decay measurements. In essence, it is a tool to quantitatively investigate magnetic properties of a given material. It can be used to study the DC magnetic properties of materials as a function of magnetic field (max. up to 2.2 T) and temperature (100 K to 800 K).



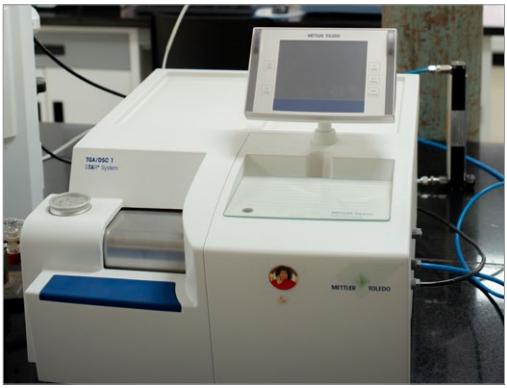
1C: THERMAL AND OPTICAL CHARACTERIZATION FACILITIES

Thermogravimetric Analyzer (TGA/DSC-1, Mettler Toledo)

Features

» Sub-microgram resolution over the whole measurement range
» Analyze samples from 25°C - 1600°C
» DSC option for simultaneous measurement of heat capacity associated with thermal events

Validate thermal stability and the related thermal characteristics of the materials.



Differential Scanning Calorimeter (DSC) DSC 200 F3 Maia Thermal Analyzer (Netzsch)

Features

» Temp. range: -150°C to 600°C
» Heating rates (K/min): 0.001 to100
» Cooling rates (K/min): 0.001 to100
» Sensor: heat flux system
» Measurement range (mW): 0 to ± 600
» Temp. accuracy: 0.1 K
» Enthalpy accuracy: generally < 1%
» Cooling options: Forced air (down to RT)
» Atmospheres: oxygen, inert (static, dynamic)

Thermodynamic parameters associated with a variety of materials such as specific heat, entropy and enthalpy change can be assessed. This helps in distinguishing crystalline and non-crystalline materials. The phase transitions associated with plethora of materials can be ascertained.

Dynamic Light Scattering (DLS) Particle Analyzer Anton Paar - LitesizerTM 500

Features

General

» Temp. control range: 0-90^{0}C
» Light source: Laser/ 40 mW, 658 nm

Particle size specifications

» Measuring range: 0.3 nm – 10 µm (particle diameter)

Sensitivity

» Min. conc. (protein): 0.1 mg/mL (lysozyme)
» Min. conc. (polymer): 1 µg/mL (polystyrene latex)
» Min. sample volume: 12 µL
» Measurement angles: 15^0, 90^0, 175^0

Zeta potential specifications

» Measuring range: -600 to +600 mV

Molecular mass specifications

» Mass: 980 Da - 20 MDa
» Particle size: up to 40 nm (diameter)
» Mobility: 10-11 m^2/V.s to 2 x 10^{-7} m^2/V.s
» Size range: 3.8 nm-100 µm
» Sensitivity: 1 mg/mL (lysozyme)
» Max. sample concentration: 40% w/v
» Sample volume: 350 µl
» Max. sample conductivity: 200 mS/cm

Refractive index specifications

» Measuring range: 1.28 to 1.50
» Temp. range: 0^{0}C to 90^{0}C
» Wavelength: 658 nm
» Min. sample volume: 1mL

Capabilities

The Litesizer™ 500 is an instrument for characterizing nano- and microparticles in dispersions and solutions. It determines particle size, zeta potential, and molecular mass by measuring dynamic light scattering (DLS), electrophoretic light scattering (ELS), and static light scattering (SLS).

Interestingly, the Litesizer™ 500 is the only DLS-based particle analyzer that is able to perform a straightforward measurement of the sample's refractive index.

Dilatometer: DIL802 Horizontal Dilatometer (TA instruments)

Features

» RT to 1350^{0}C
» Measuring systems: fused silica, $Al_2 0_3$, graphite
» Sample length: 0 to 50 mm
» Change of length: 4 mm (maximum)
» Length Resolution: 10 nm

Capabilities

To employ materials in a wide range of temperatures, one needs to have a prior knowledge about the thermal characteristics of materials, specifically its expansion.

This instrument is aptly designed to monitor the expansion of materials on heating, even at elevated temperatures.

DTA: Q600 SDT Simultaneous DSC-TGA (TA instruments)

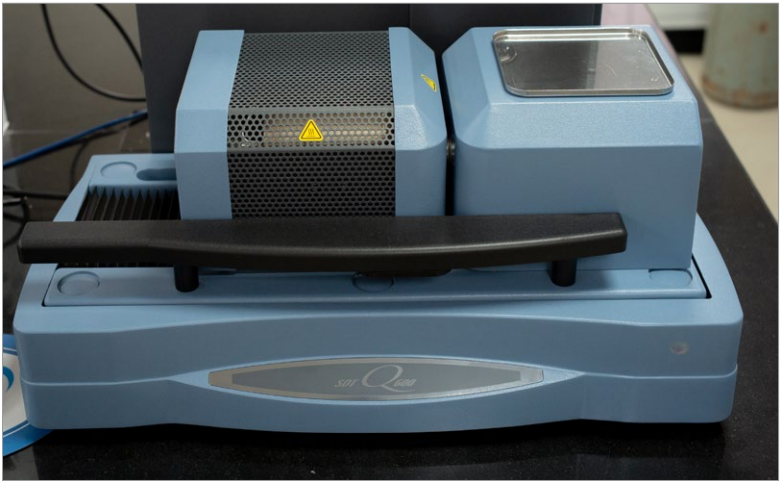
Features

» System Design: Horizontal Balance and furnace
» Balance Design: Dual Beam
» Sample Amount: 200mg
» Furnace type: Bifilar Wound
» Temp. range: Ambient to 1500^{0}C

Capabilities

» Supports both DSC & TGA measurements;
» Less drift compared to single-beam designs;
» Independent TGA measurements on two samples simultaneously.

The chemical reaction kinetics associated with certain thermodynamic parameters can be studied. This will also help in distinguishing crystalline materials from that of glasses and polymers.



Cary Eclipse Fluorescence Spectrophotometer (Agilent)

Features

» Source: Xe pulse lamp with exceptionally long lifetime, pulsed at 80 Hz.
» Pulse width at half peak height ~ 2 µs, peak power equivalent to 75 kW.

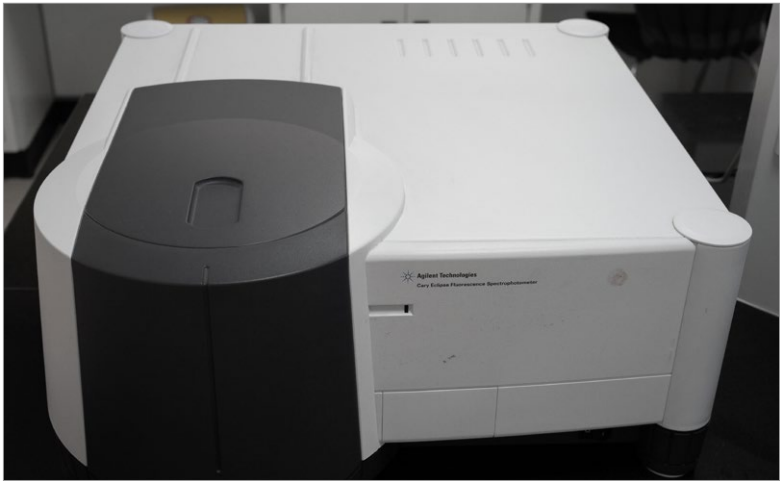
Wavelength range:

» Excitation: 190-1100 nm. Zero Order (ZO) selectable.
» Emission: 190-1100 nm. ZO selectable.
» Operational excitation: 200-900 nm with standard PM tube. ZO selectable.
» Operational emission: 200-900 nm with standard PM tube. ZO selectable.
» Wavelength accuracy: +/- 1.5 nm

Capabilities

» Characterize bio-labels for live cell imaging
» Characterizing GPCR oligomerization
» Detecting specific bacterial strains using fluorescent assay
» Understanding platelet response using cellular signaling
» Analyze changes in tertiary structure of proteins
» Thermal stability of biocatalysts and pharmaceuticals

This facility is used for both qualitative and quantitative analyses. More specific and sensitive technique than UV-Vis. Fluorescent compounds can be analyzed and estimated at nano molar level.



Cary 630 FTIR Spectrometer (Agilent)

Capabilities

- Identify and confirm plastics, elastomers, and adhesive materials
- Verify the composition & quality of composites, coatings and thin films
- Analyze contaminants during semiconductor processing and solar cell manufacturing
- Determination of trans fat content of edible fats and oils
- Rapid authentication & detection of adulteration of food, herbal medicines & dietary supplements
- QA/QC of various foods, such as coffee, tea, sugar and flour
- Free Fatty Acid (FFA) & Iodine Value (IV) determination in oils
- Analyze API's and drug products for overall purity and conformity
- Determine if drug samples are counterfeit or adulterated.
- A powerful tool for identifying types of chemical bonds in a molecule by producing an IR absorption spectrum that is like a molecular 'fingerprint'

Qualitative analysis can be done with this instrument. It gives information about the presence of functional groups in compounds. Hence, it is of use in structure elucidation. ATR facility helps to analyse samples in solution state as well.

Cary 60 UV-Vis Spectrophotometer (Agilent)

Features

- Source: Unique full-spectrum Xe flash lamp (80 Hz)
- Monochromator: Czerny-Turner
- Grating: Holographic, 27.5 x 35 mm, 1200 lines/mm, blaze angle 8.6° at 240 nm
- Detectors: 2 silicon diode detectors UV-Vis limiting resolution (nm): ≤ 1.5 nm
- Optical design: Double beam Czerny-Turner monochromator
- Toluene/hexane limiting resolution (EP/BP and TGA test): ≥ 1.5
- Wavelength range (nm): 190-1100 nm accuracy (nm): ± 0.5 at 541.94 nm; reproducibility (nm): ± 0.1 nm

Capabilities

- Characterization of unknown or newly synthesized compounds
- Monitoring kinetics of chemical / biological reactions occurring at sub-sec rate
- Measurement of films and optical components
- Analyzing small amounts of precious samples (< 4 µL)
- Colour measurements and colour matching
- Analysis of nutrients in water, food and agriculture
- Analysis of turbid solutions or relatively highly absorbing samples
- Analysis of bulk optics (e.g., sunglasses)
- Study of pigments in art conservation through reflectance measurements

UV/Vis spectroscopy is routinely used in analytical chemistry for the quantitative determination of different analytes, such as transition metal ions, highly conjugated organic compounds, and biological macromolecules. Spectroscopic analysis is commonly carried out in solutions but solids and gases may also be studied.

Microwave Plasma Atomic Emission Spectroscopy (Agilent) 4200 MP-AES

Features

- Detector: Hermetically-sealed, UV-sensitive, back-thinned solid state CCD detector (532 x 128 pixels)
- Signal stability: < 2% RSD over 2 hours without internal standardization or any form of drift correction.
- Resolution: < 0.050 nm (measured as FWHM)
- Detection limits: 3 sigma detection limits (µg/L) using a 10 second integration time.
- Pure nitrogen and nitrogen generator IDLs

Element	Full environmental range
Mn 257.610 nm	5.00 ppb
Ba 614.171 nm	1.5 ppb

Capabilities

MP-AES consists of a microwave induced plasma interfaced to an atomic emission spectrophotometer (AES). It is used for simultaneous multi-analyte determination of major and minor elements. MP-AES employs microwave energy to produce a plasma discharge using nitrogen supplied from external sources or extracted from ambient air, which eliminates the need for sourcing gases in remote locations. Samples are typically nebulized prior to interaction with the plasma in MP-AES spectroscopy.

UV/Vis/NIR Spectrophotometer (LAMBDA 1050 - Perkin Elmer)

Features

- A unique PMT, InGaAs and PbS 3-detector module for testing across the entire UV/Vis/NIR range.
- Sources of Light: Tungsten-halogen and Deuterium
- Operating Range: 175-3300 nm
- Resolution: 0.2 nm

Capabilities

The UV/Vis/NIR Spectrophotometer can be used to achieve significant performance breakthroughs across a range of applications; from simple optical absorbance and reflectance measurements a wide wavelength range (175-3300 nm) for solid and liquid samples to quantifying out-of-band blocking characteristics of band pass filters and also measuring the high transmission of next generation fiber optic materials.

The optical transmission windows of a variety of materials in different configurations can be determined.

Brunauer-Emmett-Teller (BET) Surface Area Analyser

Features

» Two micropore analysis stations, and two dedicated built-in sample preparation (degas) ports.
» Computer-controlled ramp/hold/test protocols, and a dedicated cold-trap.
» A dedicated Po (saturation pressure) transducer
» Long life dewar (90+ hours, even with two samples)
» Thermostatted Bath for measurements at, or around, room temperature

Capabilities

» Characterization of the mesoporous (2-30 nm) and macroporus (>50nm) materials, including activated carbons/fibers and nano-carbon fibers, metal supported catalysts.
» Comprehensive physisorption calculations include specific surface area (single and multi-point B.E.T., Langmuir, STSA, t-plot, alpha-s, DR), pore size (BJH, DH, DA, MP, HK, SF, Monte-Carlo, NLDFT, QSDFT) with their corresponding surface area values.

2A: WET CHEMISTRY LABORATORIES

State-of-the-art Wet Chemistry Laboratories

These laboratories have world class work benches and fume cupboards. Fume cupboards are equipped with vacuum as well as inert gas facilities.

All operations required in synthetic experiments can be carried out. These include reactions at both low and high temperatures, reactions in inert gas atmosphere, low pressure distillations etc.

These laboratories are also useful in carrying out chromatographic experiments for the separation of compounds. They are equipped to synthesize functional materials (organic and inorganic) at different length scales (includes nanometer to micrometer sized crystallites) using a variety of synthetic routes.

2B: FUNCTIONAL MATERIALS LABORATORY

d33 meter (APC International)

Features

» Measurable d33 range
  x0.1 range: 1-200 pC/ N
  x1 range: 10-2000 pC /N

» Resolution
  x0.1 range : 0.1 pC/ N
  x1 range : 1 pC /N

» Shunt capacitance
  x0.1 range: 0.1 pF
  x1 range: 1 pF

» Force
  Frequency: 110 Hz
  Amplitude: 0.25 N

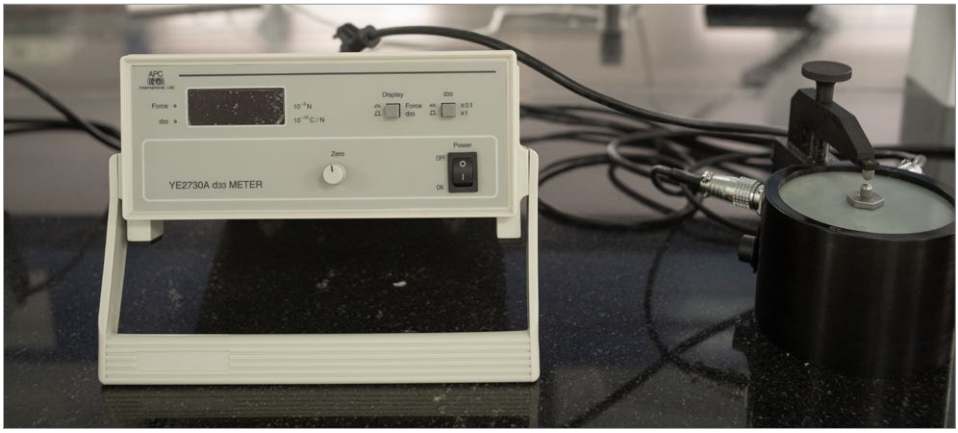
» Power
  110-240 VA
  C / 50 / 60 Hz / 20 W

Capabilities

» Quality assurance of piezoelectric materials
» In-line production inspection
» Research and development applications involving piezoelectric materials

The piezoelectric charge constant, 'd', is the mechanical strain experienced by a piezoelectric element per unit of electrical energy applied, or, alternatively, is the electrical energy generated by the element per unit of mechanical stress applied. For many device applications, a fast, easy means of determining d33 is invaluable for ensuring quality and consistency among piezoelectric ceramic components. This instruments facilitates the measurements of piezoelectric coefficients of mutlfunctional materials.

» Accuracy
  x0.1 range: ± 5% of d33 value from 1-20 pC/ N
  ± 2% of d33 value from 10-200 pC/ N
  x1 range: ± 5% of d33 value from 10-200 pC/ N
  ± 2% of d33 value from 100-2000 pC/ N



LCR meter (4100: Wayne Kerr)

Features

» Frequency Range: 20 Hz to 100 kHz
» Any of the following parameters can be measured and displayed:

Impedance (Z)	Phase Angle(Ø)	Capacitance (C)	Dissipation Factor (D)
Inductance (L)	Quality Factor (Q)	AC Resistance (Rac)	Reactance (X)
Susceptance (B)	Conductance (G)	Admittance (Y)	

AC measurements

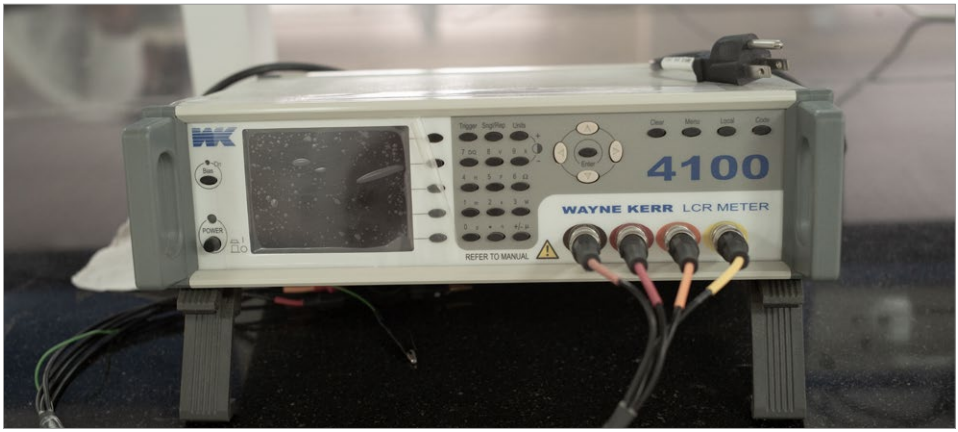
» Open circuit: 10 mV to 2 V rms
» Voltage step size: 10 mV (200 steps)
» Short circuit: 100 µA to 20 mA rms
» Current step size: 100 µA (200 steps)
» Signal source impedance: 100 Ω
» DC Bias Voltage: Internal - 2 Vdc (External - up to ±40V may be connected via rear panel)

Measurement Ranges

Z, R, X	0.01 mΩ to > 1 GΩ
Y, B, G	0.1 nS to > 2 kS
L	1 nH to > 2 kH
D, Q	0.0001 to 9999.9
Phase Angle	-180° to +180°
Rdc	0.1 mΩ to > 100 MΩ

Capabilities

To study the capacitance, inductance and impedance of the materials as a function of both the frequency and temperature and also to find out the piezoelectric properties by resonance - anti-resonance methods. The above parameters could be used in the design of electrical filters, capacitors, piezoelectric transducers etc.



Impedance Analyzer (Model 6500B: Wayne Kerr)

Features

» Any of the following parameters can be measured and displayed:

Capacitance (C)	Inductance (L)	Resistance (R)	Reactance (X)
Conductance (G)	Susceptance (B)	Impedance (Z)	Dissipation Factor (D)
Admittance (Y)	Phase Angle (Ø)	Quality Factor (Q)	

» Frequency Range: 20Hz to 120MHz
Frequency step size 0.1 mHz
Accuracy of set frequency ±0.005"%

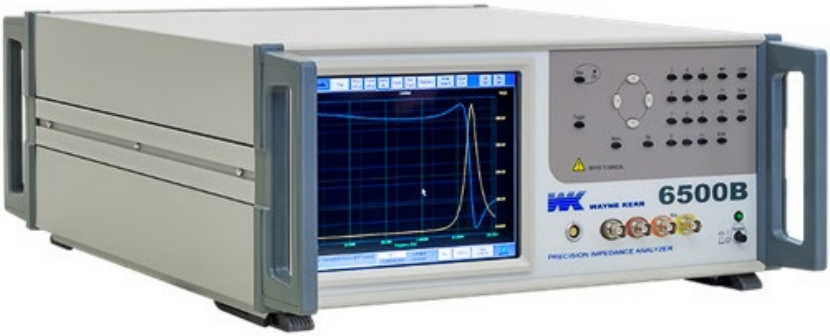
» AC Drive Level: 10 mV to 1V rms (varies with frequency)
200 µA to 20 mA rms (varies with frequency)

» Accuracy: Dissipation factor - ±0.0005 (1+D2)
Quality factor - ±0.05 % (Q+1/Q)
Capacitance / Inductance / Impedance - ±0.05%
Accuracy varies with frequency, drive level and measured impedance

» DC Bias Current (Option): 0 to +100mA dc bias current and
0 to +40V dc bias voltage
-40V to +40V dc bias voltage

Capabilities

This instrument can be employed to determine the capacitance, inductance and impedance characteristics of materials over a wide range of frequencies. These studies indeed help in the design of piezoelectric based sensors and actuators.



PE Loop tracer (Marine India)

Characterization of Ferroelectric materials

Features

General Specifications

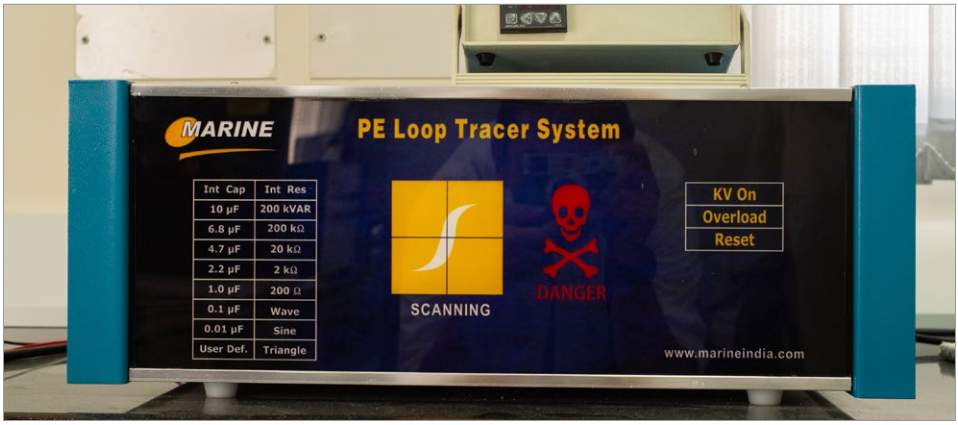
- Field 5 kV
- Frequency 20 Hz to 1 kHz
- Fatigue up to 20th order of cycles
- Resolution 16 bit
- Temp. RT- 400^{0}C with PID control
- Furnace and sample holder for bulk samples
- Complete data transfer to standard software like Origin xls.
- Full touch screen operation using smart 7" touch panel mounted on the unit
- Data transfer using USB stick
- LAN port for multiple connectivity and remote maintenance
- Absolutely no PCI/USB/ISA/RS232 interface required
- 19" rack mountable unit
- Silicon oil 500mL
- In built temperature interface for K type thermocouple

System test specifications

- Electric Field 100 kV/cm for 0.5 mm thick samples
- Min. charge sensitivity of bulk 0.01 uC
- Max. charge measurement 100 uC
- Min. sample area 1 sq mm
- Max. Sample diameter 10-15 mm
- Max. Sample thickness 3 mm
- 16 Bit Wave form generator
- 16 Bit AD convertor

The following experiments can be performed with the system.

- Polarization (P) Vs Electric Field (E) studies at different frequencies and temperatures
- PE fatigue measurement



B-H Loop tracer (Marine India)

Characterization of magnetic materials

Features

- Frequency of operation 20 Hz to 1 kHz user selectable
- Max current: 2 amp
- Max voltage (AC): 20 V
- 12 bit Data collection unit
- Data processing unit
- Overload protection
- Input 220 Volts 50 Hz
- 19" rack mountable unit

The following tests can be performed with the system:

- BH loop at diff. temperatures.
- BH loop at diff. frequencies
- BH fatigue measurement

Capabilities

The system helps in assessing the magnetic nature of materials such as ferrites, and the other smart magnetic materials via B Vs H Loop studies. The sample is generally cylindrical, and the cylindrical ring in shape can be hollow, or a rod. Two insulated windings are generally done on the sample. One is called primary of known thickness and no. of turns.
The other is called secondary of known thickness and turns. Electrical AC signal of different frequencies is applied in one and due to magnetization output signal is read simultaneously in secondary winding.

DC/RF Sputtering Unit

Features

» Vacuum Chamber: D-Shape / Cylindrical Chamber
» Pumping System: Turbo Pumping System
» Vacuum Gauges: Digital – Pirani & Penning Gauges
» Substrate Holder with Spring clips arrangement
» Substrate Heating 500°C & Rotation Mechanism
» Mass Flow Controllers for introducing gas
» RF 300 Watts; Power Supply with auto matching network
» 1 kW DC Power Supply

Capabilities

This could be used to configure metals and oxides in two dimensional thin-film configurations. Thin-films can be deposited on various substrates for a variety of applications which include energy harvesting devices, optical limiters, piezo and ferroelectric sensors.

High Temperature Furnaces

Carbolite HTF 1700

Features

» Heating elements : Molybdenum disilicide.
» Temperature (Max.): 1700°C
» Safe operating temperature: 1600°C
» Can be used to calcine and sinter materials at elevated temperatures.

Muffle furnace (Delta power controls)

Features

» Temperature (Max.): 1050°C
» Safe operating temperature: 900-950°C
» Single Phase, 230 Volts
» Heating by Kanthal elements grooved with high temperature alumina tube,
» Temp. controlled by a digital control, complete with thyristor power pack

Tubular Furnace

Features

» Heating by silicon carbide heating elements with complete thyristor power pack.
» Temperature (Max.): 1300°C
» Safe operating temperature: 1200°C
» Single Phase, 230 Volts

All these furnaces can be employed to calcine and sinter functional materials.

Solar Simulator and Cell Tester (CT50AAA: Photo Emission Tech)

Features

- Type of lamp: Xenon Short Arc
- Lamp Power: 150 W
- Max. Illuminated area: 2" (50mm) x 2" (50mm)
- Air Mass: AM1.5G Standard (AM1.5D or AM1 optional)
- Lamp lifetime: 1,500 hours
- Simulator Class: AAA
- Phase/Voltage/Frequency: Single Phase/110-220AC Volts/50-60Hz
- Adjustment Range of light intensity: 1000 W/m2 +/- 15%
- Max. Power Consumption: 650 W
- High quality Solar Simulator with computer control
- Intensity measurement and feedback control for long term stability.
- Flexible cell test fixture configurations, including optional cell temperature control (10°C to 70°C ±0.5°C or better).
- True four-probe cell contacting technique.
- Temperature controlled chuck with vacuum hold.
- Multiple cell contacting probes for larger cells.
- Ability to determine Thermal Coefficients of various cell parameters.

Testing of various Solar Cells for their efficiencies under Standard Test Conditions.

2C: WATER RESEARCH AND ELECTROCHEMISTRY

Electrochemistry Laboratory

This facilitates working on Novel catalysts that can specifically be tuned to wide spectrum of applications in the energy sector. Also includes:

» hydrogen evolution reactions
» oxidation reactions of Ethanol, Methanol, Glycerol and Ethylene glycol

These novel catalytic materials can be used as model substrates for decolorization of organic dyes, with a focus on environmental remediation.

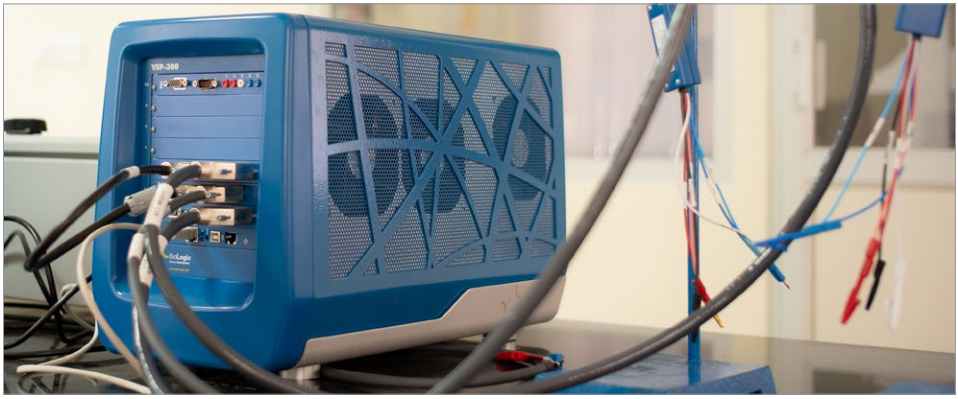
Electrochemical Workstation VSP-300 (BioLogic) Up to 6 channels

Features

» Potential resolution: 1 µV
» EIS measurement: 10 µHz – 3 MHz (1%, 1°), 10 µHz-7 MHz (3%, 3°)
» Current ranges: 1 A to 10 nA (standard)
» Maximum current: ±500 mA (standard)
» Up to 40 A with boosters in parallel
» Current resolution: 760 fA (standard)
» Low current: 6 ranges from 100 nA to 1 pA with resolution to 76 aA
» Floating mode; Analog filtering
» Calibration board
» Full stability control mode (9 bandwidths)

Capabilities

This equipment can be employed to test: Battery & Intercalation Compounds, Battery Cycling, Capacitor and supercapacitor, Corrosion & Coatings, EIS, Electrochroms, Fuel Cell and Biofuel Cell.

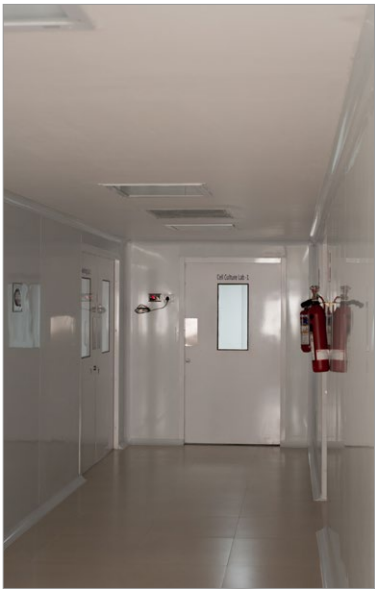


3A: BIOSAFETY LABORATORIES – Level 1 & Level 2

Biosafety Levels are a means to determine the level of danger (Bio-hazardous) to the researchers & others while working with biological / clinical samples that can cause diseases. Hence a clean environment is created in these laboratories through Air handling systems fitted with HEPA filters.

BSL-1 facility would be used to conduct experiments related to molecular biology involving gene cloning, DNA amplification using PCR, ELISA, Western blotting, Fluorescence associated cell sorting (FACS) analysis and protein purification.

BSL-2 facility, would be used to process clinical samples and biological specimens of Disease biology projects like Avascular Necrosis (AVN) of the femoral head, Huntington disease, Rheumatoid arthritis and Glaucoma.



Thermo Scientific BB 150 CO_2 Incubator

Features

- Interior volume 150L / 5.3 ft^3
- Chamber construction Type 304 stainless steel, electropolished
- Temp. above ambient -55°C
- CO_2 Control: 0-20%

Fan Assisted Circulation

The BB 150 CO_2 incubator airflow patterns are designed for optimal distribution of critical environmental conditions. Efficient circulation minimizes variation between cultures while preventing desiccation.

Accurate temperature Control

Featuring reliable direct heat technology with high efficiency heaters on all sides of the culture chamber. In case of failure a backup circuit maintains control to ensure the stability of temperature at the desired value.

Convenient auto start technology

This provides automatic adjustment of the CO_2 measuring system at temperature set point with humidity, providing system optimization for best results. Advanced design of this CO_2 incubator promotes optimal growth & maintenance of cell cultures.

Real Time PCR System (Applied Biosystems QuantStudio® 5)

Features

- Format: 384 well block
- Reaction Volume: 5-10 µl
- Multiplexing – Up to 5 targets.
- Max. block ramp rate - 6.5°C/sec
- Average sample ramp rate - 3.66°C/sec
- Temp. Uniformity - 0.4°C
- Temp. accuracy - 0.25°C
- 384 wells peltier based heating and cooling.
- OptiFlex® technology - 5 coupled excitation and emission filters with bright white LED as light source.
- Advanced CMOS imager system for data acquisition.
- Excitation/detection range - 450–650 nm/500–700 nm.
- Heated cover temperature range of 50-110°C
- Run time: <30 min
- Dye Compatibility: FAM™/SYBR® Green, VIC®/JOE™/HEX/TET, ABY®/NED™/ TAMRA™/ Cy®3, JUN®, ROX™/ Texas Red®, Mustang purple, Cy5/Liz, Cy5.5
- Can detect as low as 1 copy of and sense as small as 1.5-fold in target quantities.

Capabilities

- Gene Expression, Genotyping, Copy number variation, Pathogen detection, Strain typing, and miRNA Profiling,
- Protein thermal shift analysis

This facility is used to qualitatively measure the amplification of DNA/RNA using fluorescent dyes.

Incubated/Refrigerated Stackable Shakers (MaxQ™ 6000)

Features

» Rotation range: 15 to 300 rpm
» Temp. Range: -15^{0}C to 60^{0}C

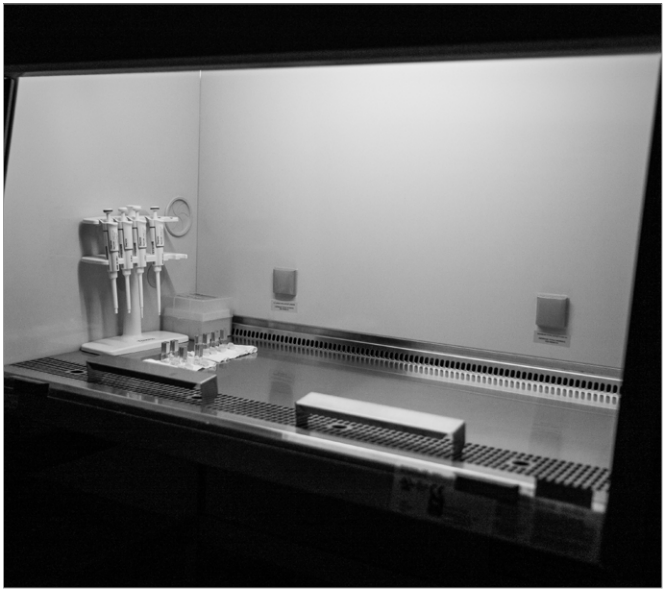
Capabilities

Offers sample storage and orbital shaking

Biological Safety Cabinet (1300 Series Class II, Type A2)

Capabilities

» Materials contaminated with pathogens requiring a defined biosafety level can be handled safely, ensuring personnel, sample and environment protection.
» This helps in preventing the escape of biological aerosols into the laboratory environment



Heraeus Megafuge 8R Centrifuge

Features

» 580mL capacity (4 x 145 mL)
» 99-program memory
» 15 optional rotor systems
» Powerful refrigeration system for precise control of temperature

Capabilities

» Aerosol biocontainment facility
» Runs up to 24 x 5/7mL blood tubes at a time in swinging bucket configuration.
» Quick switch between applications- from conical tubes to blood tubes, and from microtubes to microplates

NanoDrop 2000C Spectrophotometer (ND-2000C-IND)

Features

» Heating: 37 ± 0.5°C Stirrer: 150-850 RPM
» Pathlength: 10, 5, 2, 1 mm
» Detection Limit: 0.4 ng/µL dsDNA
» Maximum Concentration: 750 ng/µL

To quantify and assess purity of DNA, RNA and Protein

Multimode Microplate Reader Varioskan LUX (Thermo Scientific)

Features

Mode/ Parameter	UV-VIS	Fluorescence	Time Resolved Fluorescence	Luminescence
Excitation/ Absorbance	200-1000nm	200-1000nm	Fixed at 334nm	360-670nm
Emission		270-840nm	400-700nm	----
Light source	Xenon flash lamp	Xenon flash lamp	Xenon flash lamp	----

Incubator and Shaker

Temp. range: From ambient +4 ^{0}C to 45 ^{0}C
Shaking type: Orbital

Integrated Gas Module

CO_2 concentration range: 0.1% to 15%
CO_2 concentration stability: ±0.3% to 5% CO_2
O_2 concentration range: 1% to 21%
O_2 concentration stability: ±0.3% to 1% O_2

Capabilities

Reporter gene assays, Growth Kinetics, ATP measurement using Luciferin-Luciferase, Spectral scanning for assay optimization, Integrated gas module for atmospheric control of CO_2 and O_2 for cell based assays, Live cell calcium imaging studies and high throughput drug screening.

3B: FUNCTIONAL GLASSES AND CERAMICS LABORATORY

High Temperature Furnaces (Thermolyne 46100)

(Number of furnaces: 3)

Features

- Heating elements: Six u-shaped Molybdenum disilicide ($MoSi_2$)
- Temperature (maximum): 1700°C
- Safe Operating Temperature: 1500°C
- Advisable to operate in air ambience only
- Single phase (220-240V)
- Input current 10A/40A (with corresponding power of 2500W/9600W)
- Digital programmable temperature controller with one stored progam of eight segments. It has a precious Type B thermocouple

Capabilities

Could be employed to calcine/sinter high temperature inorganic oxides for multifarious applications. It could be employed to fabricate glass-ceramics as well.

High Temperature Glass Fabrication Facility (Lenton 1600 Elevator Hearth Furnace)

Features

- Heating elements: Ten u-shaped Molybdenum disilicide ($MoSi_2$)
- Temperature (maximum): 1600°C
- Safe Operating Temperature: 1400°C
- Advisable to operate in air ambience only
- Single phase (220-240V), 40A
- Digital programmable temperature controller with precious Type B thermocouple along with high ramp rates

Capabilities

High temperature oxides could be melted and quenched into glasses. The crucible/ container holding the molten material could be lowered to an operating level for quenching.

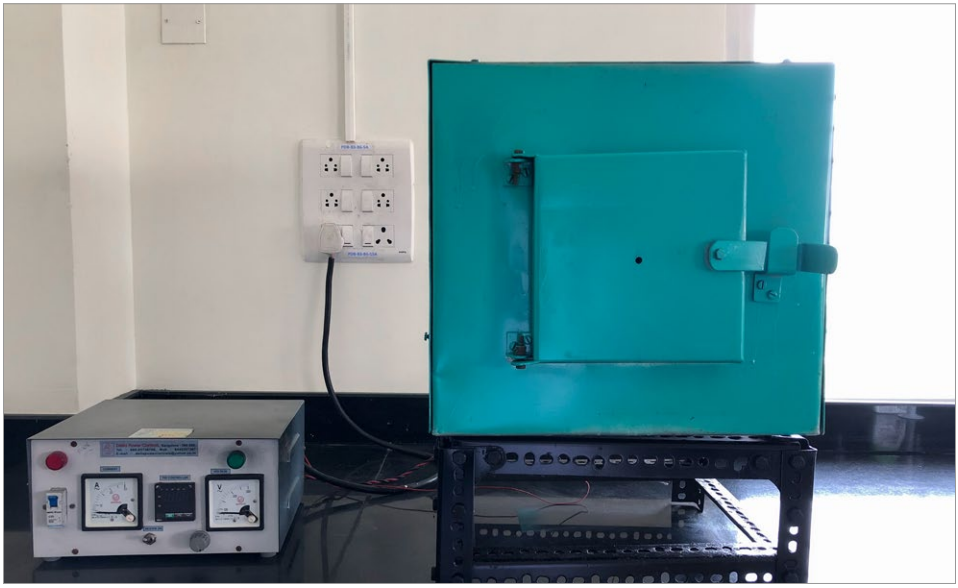
Muffle Furnace (wire-wound)

Features

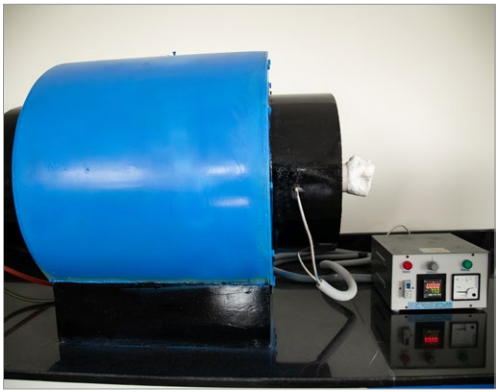
» Heating elements: Kanthal wire
» Temperature (maximum): 800°C
» Safe Operating Temperature: ≈700°C (for continuous operation)
» Advisable to operate in air ambience only
» Single phase (220-240V), 15A
» Digital programmable temperature controller with one stored program of eight segments. It has a Type K Thermocouple

Capabilities

» Could be used to calcine/sinter mostly inorganic oxides that have moderate melting points (≈700°C).
» Can also be employed to fabricate glass-ceramic at different length scales.



Tubular Furnace



Features

- Heating elements: Six Silicon Carbide (SiC)
- Temperature (maximum): 1200°C
- Safe Operating Temperature: 1000°C (for continuous operation)
- Single phase (220-240V), 50/60 Hz. Input current 32A
- Digital programmable temperature controller with one stored program of eight segments. It has a Type K Thermocouple

Capabilities

- Could be employed to synthesize/calcine materials in a controlled ambience

Glass Annealing Furnace (Delta Power Controls)

Features

- Heating elements: Kanthal wire
- Temperature (maximum): 800°C
- Safe Operating Temperature: 600°C
- Single phase (220-240V), <10A
- Digital programmable temperature controller with one stored program of eight segments. It has a Type K Thermocouple

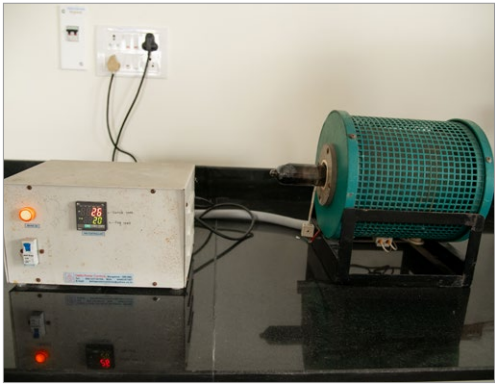
Capabilities

- Could be employed to anneal glasses below the glass transition temperatures. It could also be employed to fabricate glass-ceramics.

Tubular Furnace (Delta Power Controls)

Features

- Heating elements: Six Silicon Carbide (SiC)
- Temperature (maximum): 1200°C
- Safe Operating Temperature: 1000°C (for continuous operation)
- Single phase (220-240V), 50/60 Hz. Input current 32A
- Digital programmable temperature controller with one stored program of eight segments. It employs a Type K Thermocouple



Capabilities

- Could be employed to synthesize/calcine materials in a controlled ambience

Electrical Polling Unit

Features

» DC power source of variable voltage and current
» Voltage can be varied from 0-10 kV
» The maximum current that can be drawn from this source is 10mA

Capabilities

» This facility can effectively be employed to electrically poll the ceramics / single crystals / polymers in different configurations. The polling can be achieved at different temperatures as well.

Single Crystal Puller (Czochralski technique)

Features

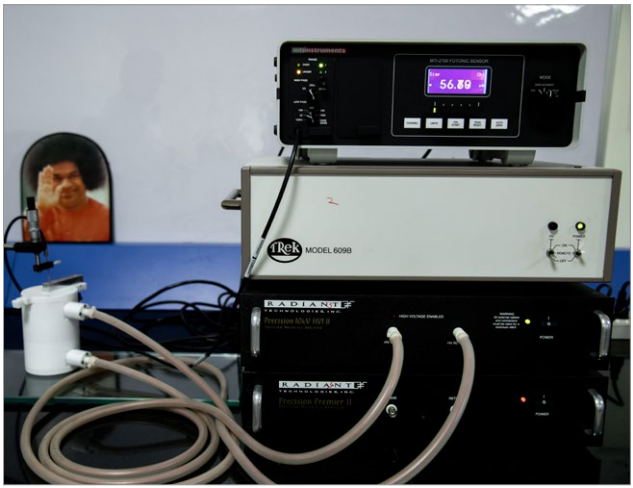
» Single crystals of both organic and inorganic materials can be pulled/grown from their melts at different rates (i.e. 0.1mm to 40mm/h)
» Faster withdrawal of the growing crystal facility exists
» Stroke length is nearly 100 cm
» The diameter of the crystal to be grown is variable
» The growing crystal could be rotated at different rates (5-20 rpm)
» The temperature range can be varied depending on the type of furnace one employs/chooses. Temperature is controlled to an accuracy of ±0.5°C using a digital temperature controller

Capabilities

» Optical quality large single crystals of both organic and inorganic materials could be grown from their melts in air ambience. There exists a provision to grow single crystals in a controlled atmosphere.

3B: NON-LINEAR OPTICS LABORATORY

Ferroelectric/Converse Piezoelectric Tester (Precision Premier II)



Capabilities

- Ferroelectric Hysteresis (PE-Loop) studies, one could obtain parameters that include P_s , P_r , E_c
- Piezoelectric displacement (Strain vs Electric field/ Butterfly curve), converse piezo coefficient can be evaluated.

Ferroelectric Tester

Features

- Voltage Range (built-in drive voltage): ±10V, ±30V, ±100V, ±200V or ±500V built-in
- Voltage Range with an external amplifier and high voltage interface (HVI): 10 kV
- Number of ADC Bits: 18
- Minimum Charge Resolution: 0.80fC
- Minimum Area Resolution (assuming 1 ADC bit = 1μC/cm^2): 0.080μ^2
- Maximum Charge Resolution: 5.26mC
- Maximum Area Resolution (assuming saturation polarization = 100μC/cm^2): 52.6cm^2
- Maximum Charge Resolution with High Voltage Interface (HVI): 526mC
- Maximum Area Resolution (assuming saturation polarization = 100μC/cm^2) w/o HVI: >100cm^2
- Maximum Hysteresis Frequency: 250kHz @ 10V | 50kHz @ 30V | 50kHz @ 100V | 50kHz @ 200V | 2kHz @ 500V
- Minimum Hysteresis Frequency: 0.03Hz
- Minimum Pulse Width: 0.5μs
- Minimum Pulse Rise Time (5V): 400ns
- Maximum Pulse Width: 1s
- Maximum Delay between Pulses: 40ks

- Internal Clock: 25ns
- Minimum Leakage Current (assuming max current integration period = 1s): 1pA
- Maximum Small Signal Cap Frequency: 1MHz
- Minimum Small Signal Cap Frequency: 1Hz
- Output Rise Time Control: 10^5 scaling
- Input Capacitance: -6fF
- Electrometer Input All Test Frequencies for all test at any speed: Yes

Converse Piezoelectric Tester

Converse Piezoelectric / Strain Tester

The MTI-2100 features advanced fiber-optic non-contact sensor using reflectance electronic technologies for precise measurements of displacement, active vibration control, position, and distance for dynamic measurement in cryogenic, vacuum / high pressure, or in high magnetic field and harsh environment. It sets new performance standards with resolution up to 0.01 µin. (2.5 Å) and frequency response from direct-coupled (dc) up to 500 kHz.

Features

- Digital display in engineering units
- Dual-channel capability permits simultaneous measurements of amplitude and phase.
- Reflective compensated units available to automatically adjust to target reflectivity changes.
- Digital display readout in engineering units eliminates the need to convert volts to displacement.
- Out-of-range indicator notifies the user if the target moves out of the linear range.
- Interchangeable probe modules allow the user to select from seven standard fiber-optic probe designs, providing 14 different standard measurement ranges and resolutions.
- High-resolution module resolves to 0.1 µin. standard or 0.01 µin. (2 Å) optional. With external filtering, 0.004-µin. (0.1nm) resolution is possible.
- Standard 0-to-10 V dc analog real-time output is compatible with most signal conditioning equipment.
- RS-232 output for computer interfacing

Piezoelectric test-bench

Features

- Range: 1-2000 pC/N
- Test frequency: 110 Hz
- Force amplitude: 250 mN

Capabilities

One could determine the piezoelectric coefficients in two different modes (i.e. d33 and d31) for functional ceramics, composites, etc.

Pyroelectric set-up (Chynoweth technique)

Features

- He-Ne Laser Source
- Signal conditioner: SRS 830 – Lock-in amplifier
- Lock-in frequency range: 1 mHz to 102.4 kHz
- Amplitude Sensitivity: 2 nV
- Modulator: Variable frequency optical chopper

Capabilities

It is employed to determine pyroelectric coefficient of functional ceramics/polymers/single crystals. These data can be used to design and fabricate pyroelectric detectors and sensors.

Electro-optic test-bench

Features

» Laser source: Argon-ion Laser
» Wavelengths: 457.9 nm, 488 nm, 514.5 nm
» Optical Power output: 40 mW
» Detectors: Photodiode/Photomultiplier
» DC power source: 20 kV / 30 mA
» Optical bench with high quality polarizers along with sample mounts

Capabilities

This set-up can be effectively employed to measure electro-optic coefficients of different materials under DC conditions at three specific wavelengths. It has provision to make measurements under AC conditions as well. This forms an effective amplitude/intensity modulator to be exploited for optical communication purpose

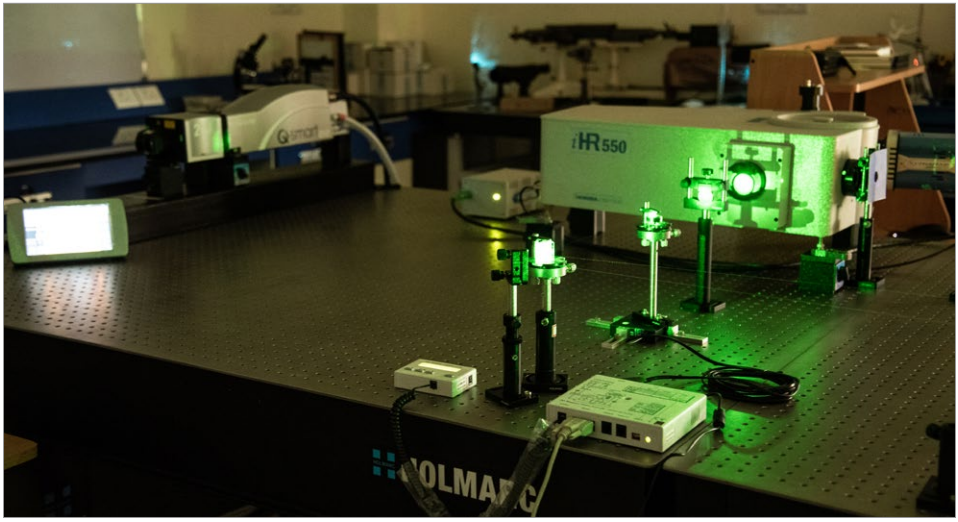
Non-linear optical coefficients measuring set-up (Second harmonic generation studies)

Features

» Laser source: Pulsed Nd:YAG laser
» Wavelengths: 1064 nm, 532 nm, 355 nm
» Optical energy: 850 mJ @ 1064 nm, 400 mJ @ 532 nm, 300 mJ @ 355 nm
» Pulse width: 5-10 ns
» Repetition rate: 1-10 Hz
» Sample rotation stage: 4 mdeg precision
» Signal detection: Low light detection PMT unit
» Spectrometer: resolution 0.001 nm, wavelength range: 300-900 nm

Capabilities

This set-up is effectively used to make non-linear optical coefficients of functional materials in different configurations. The rotation stage that is associated with it could be employed to generate Maker fringes and therein one can calculate coherence length and NLO coefficients.



Low temperature Raman and Photoluminescence Spectrocopy

Features

» Laser source: Diode lasers (405nm, 532 nm, 589 nm)
» Cryostat: Variable Temperature Pour Fill Liquid Nitrogen Cryostat (77 K)
» Temperature controller – Lakeshore 320
» Spectrometer- ihR550 –Horiba Dispersive spectrometer
» Grating: 2400,1200,600 g/mm
» Resolution: – 0.001 nm to 1 nm
» Optical Filter- Low pass, high pass and band pass filter
» Multi-channel Detector: CCD array (1024 x 256 pixels)
» Single channel detector: PMT (200 nm to 400 nm)

Capabilities

This platform allows one to monitor both vibrational and electronic transitions of various kinds of samples using both resonant and non-resonant laser excitation. The non-ambient, low temperature measurement permits one to investigate temperature dependent phase transitions to establish structure-property correlations.

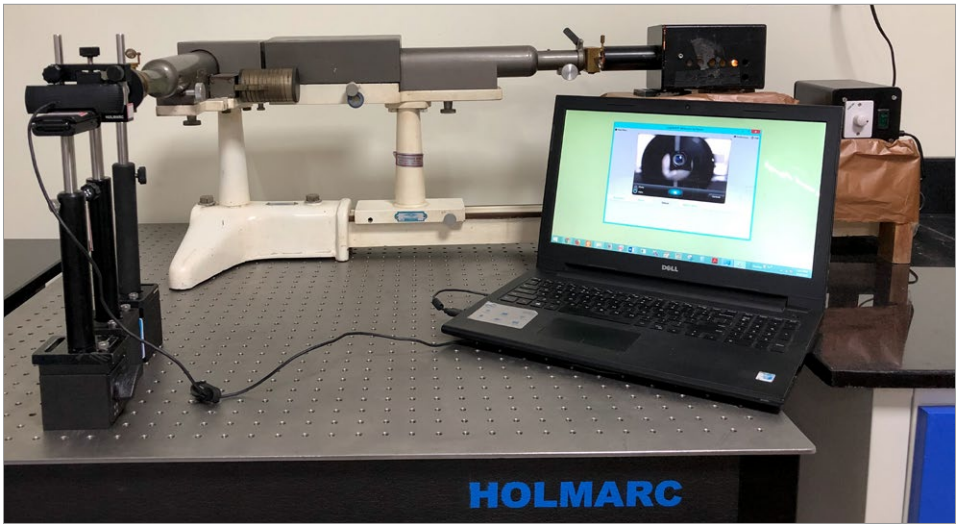
Channel Spectrum Method (Birefringence measurements)

Features

» Light Source: Tungsten Halogen lamp
» Constant Deviation Spectrometer (CDS) along with a set of polarizers to make dispersion measurements

Capabilities

This set-up would enable one to make birefringence measurements of a variety of samples at different wavelengths of light.



Refractive index measuring set-up

Features

» Laser source: RGB lasers
» Optical layout: A graduated platform to measure the angle of rotation
» Optical components: High quality polarizers along with sample mounts to hold single crystals and glass ceramics
» Optical power meter: Coherent make (10nW - 10kW)

Capabilities

A wide range of refractive indices of materials can be measured at different wavelengths of light.

3B: LIQUID NITROGEN FACILITY

Noblegen (Khione- LN20)

Features

- » LN_2 Flow : 20 L/day (or) 0.83 L/hr
- » Dewar capacity: 100 L
- » Power: 4 kW
- » Cooling water: 4.5 L/min @ 27 ^{0}C
- » Complete closed-loop design
- » Built in nitrogen PSA gas generator
- » HMI touch screen display / control
- » Medical sterile N_2 gas filter
- » Liquid level display

Capabilities

This facility helps in isolating nitrogen from air and liquefies it to 77 K. This plant has a capacity to produce 20 L of liquid N_2 per day. It augments research work to be carried out to cryogenic temperatures in the areas of physics, chemistry, biology and materials science.

3C: CENTRAL UTILITIES FACILITY

Upright Ultra-Low Temperature Freezers Forma™ 900 Series -86°C

Features

- Storage Volume: 368.1 Liters / 13.0 ft^3
- Temp. Range: -50°C to -86°C
- Unique double door to store frequently used samples in the top chamber while long-term storage remains undisturbed in bottom
- Optional CO_2 or LN_2 back-up: Choice of CO_2 / LN_2 safety back-up systems for additional sample protection in the event of a power /mechanical failure
- Optional chart recorder: Built-in chart recorder can be installed at eye level on Forma 900, -86°C models

Capabilities

Provides uncompromised sample protection for -50° to -86°C applications.

Cryogenic Storage Chest Freezers (ULT-7150-9-V24)

Features

» Capacity cu. ft. (L): 6.8 (193)
» Electrical: 220/240 V, 50 Hz single phase

Specially designed refrigeration system

» Single compressor, orbital refrigeration system designed for cryogenic storage
» Specially mixed, CFC/HCFC-free refrigerants maximize cooling and minimize environmental impact
» Downfeed evaporator provides efficient refrigerant flow for a higher system efficiency and a better cabinet temperature uniformity
» Washable condenser filter keeps fins free of dust to maintain peak cooling efficiency

Maintains uniform temperatures of -150°C. These freezers offer mechanical cryopreservation for long-term biological storage of tissue and blood samples of patients, and are safer and more convenient than LN_2 systems.

4A: COMPUTATIONAL SCIENCE AND PLASMONICS

Center for Computational Science & Molecular Modeling Simulation (COSMOS LAB)

The Computational science lab at CRIF, SSSIHL, broadly explores, the 3 facets: Medicine, Materials and Energy using Molecular Docking, Molecular Dynamics, Metabolomics, ab initio DFT studies, and QM-MM simulations.

Computer Aided Drug Design (CADD)
Functions as the symbiotic prosthetic for interdepartmental research

Multi-functional Material Design (MMD)
Innovative economic strategies in the design of multi-functional materials

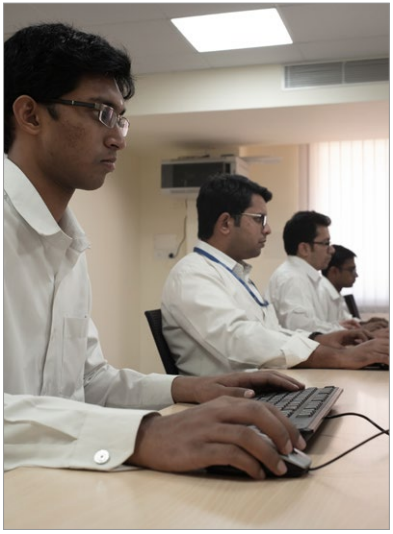
Clean Energy Design (CED)
Computational support in the intuitive rationale for the design of energy devices/fuels

Software Used

- Molecular Docking: MOE, Autodock-Vina, Gold, Schrodinger
- DFT studies: Gaussian 09, TurboMole
- QSAR: Sybyl
- Material Design: CHARMM, Material Studio, Quantum espresso
- Molecular Dynamics: Gamess, Gromacs, AMBER

Computational Materials Science

Computational prowess, using ab-initio (first principles) codes like WIEN2k and QUANTUM ESPRESSO to gain insights into various functional materials has been developed. The codes based on Molecular dynamics like LAMMPS to get thermal and mechanical properties of materials are being used. The structures of any functional materials can be studied using VESTA software, which enables theoretical prediction of XRD pattern and electron densities of the systems. Electronic structures and Fermi surfaces to comprehend the electronic properties of the system and to gain a vital insight into any other interesting properties of materials are being extensively studied. The electrical and phonon transport properties are probed using BoltzTraP and LanTraP software.



4A: PLASMONICS LABORATORY

Surface plasmon-based Translational and Advanced Research Laboratory

The research efforts of this laboratory are directed towards the development of indigenous point-of-care diagnostic devices for real-time quantification of biomarkers of different disease states. The highlight of these studies will be the use of a mobile phone camera as a detector in the Surface Plasmon-Coupled Emission platform.

These 'Make in India', mobile health technologies will aid in diagnosis and management of acute myocardial infarction, perinatal depression and vector borne diseases such as dengue, especially in resource limited settings, at a low-cost, high accuracy and reproducibility than currently existing systems. In this regard, multi-centre studies are being implemented simultaneously in Sri Sathya Sai General Hospital (SSSGH), Prasanthi Nilayam, Sri Sathya Sai General Hospital (SSSGH), Whitefield, Bangalore and Sri Sathya Sai Institute of Higher Medical Sciences (SSSIHMS), Whitefield, Bangalore.

4B: INSTITUTE INDUSTRY INTERFACE CELL (IIIC) AND APPLICATIONS OF SCIENCE TO RURAL AREAS (ASRA)

This cell essentially promotes and encourages research to be undertaken collaboratively with industries, various pharmaceutical laboratories and government and non-government research organizations. In addition, it is intended to facilitate the implementation of the scientific outcomes of SSSIHL in rural areas of our country.

4C: OPTICAL IMAGING AND INTEGRATION

Raman Microscope system with Chemical Mapping Functionalities and Optical Microscopes (Thermo Scientific)

Features

» Excitation source: Laser (λ = 780 nm laser)
» spectral resolution: 1cm^{-1}
» spatial resolution: 2 microns

Raman Microscope system embeds both micro-spectroscopy capability and automated Chemical mapping functionality for molecular finger-printing.

It also has huge spectral database that allows the user to screen multiple components for faster identification of materials of interest.

Non-ambient measurements are possible.

This platform is extensively used for characterizing functional materials (at different length scales) used in various applications like Catalysis, Pharmaceuticals, Nutraceutical & Natural Products, Biomedical, Sensors.

Raman Imaging & Spectroscopy

Raman microscope set-up that facilitates the understanding of structure-property correlation in functional materials has been established. This facility promotes inter-departmental research activity and enhances the material characterization capability pertaining to a wide variety of applications that include energy harvesting & storage; photonics; piezoelectric, thermoelectric, biomedical etc. This set-up indeed helps in identifying molecular groups prevailing in a given material.

Fiber Optic Gyroscopes

The faculty at the Department of Physics are working on the development of novel fiber optic gyroscopes housing a strong reflecting element sandwiched between fiber optic connectors to create an optical discontinuity in the path of the fiber optic resonator.

Multi-modal Microscope

Multimodal optical microscope as a cost effective disease diagnostic as well as an essential research and teaching tool has been demonstrated. This optical microscope possesses multiple functionalities like Bright Field imaging; Phase Contrasting; Edge enhancement and Fluorescence imaging: all these are provided in a single platform. The primary necessity for developing such a device arises from the growing need for affordable diagnostic tools in India.

COLLABORATORS

Academia & Research		
ICAR-Indian Institute of Horticultural Research, Bangalore	Indian Institute of Technology, Madras and Kharagpur	FDA-Center for Biologics Evaluation and Research, USA
Indian Institute of Science Education and Research, Mohali	Indira Gandhi Centre for Atomic Research, Kalpakkam	University of Maryland, USA
The Institute of Bioinformatics and Applied Biotechnology, Bangalore	Raman Research Institute, Bangalore	New Jersey Institute of Technology, USA
Tata Institute for Fundamental Research, Mumbai	Madras Diabetes Research Foundation, Chennai	Clemson University, USA
Geological Survey of India, Hyderabad	Indian Institute of Science, Bangalore	Universidad del Norte, Colombia
National Institute of Nutrition, Hyderabad	The Sahlgrenska University Hospital, Sweden	Baylor College of Medicine, USA
CSIR-National Chemical Laboratory, Pune	University of Wollongong, Australia	University of Colorado, USA
International Centre for Genetic Engineering and Biotechnology, New Delhi	National Institute of Pharmaceutical Education & Research, Hyderabad	Japan Advanced Institute of Science and Technology, Japan
CSIR-Indian Institute of Chemical Technology, Hyderabad	Institute for Photonics and Nanotechnologies, Italy	Dr. Reddy's Institute of Life Sciences, Hyderabad
Central Leprosy Teaching and Research Institute, Chennai	Centre for Materials for Electronics Technology, Pune	CSIR-Central Drug Research Institute, Lucknow
International Center for Genetic Engineering & Biotechnology, New Delhi	National Animal Resource Facility for Biomedical Research, Hyderabad	CSIR-Central Electro Chemical Research Institute, Karaikudi

Industry	
Grey Scientific Laboratories, Visakapatnam	Agilent Technologies India Pvt. Ltd.
Amara Raja Batteries Pvt. Ltd., Tirupati	Twastrix, Pune
LightMotif Automation Sensors and Systems Pvt. Ltd., Hyderabad	Omix Research & Diagnostics Laboratories Pvt. Ltd., Bangalore
Lab Engineers, Bangalore	Labby Inc., USA
Insta Power Ltd., New Delhi	Symrise Pvt. Ltd., Chennai
Indras Pvt. Ltd., Hyderabad	Syngene international Ltd., Bangalore
Mylan Laboratories, Bangalore	


CRIF

SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
PRASANTHI NILAYAM
सत्यं वद धर्मं चर

sssihl.edu.in

The end of education is character
SRI SATHYA SAI