Since 1983

MIT-WPU
॥ विश्वशान्तिर्धुवं ध्रुवा ॥

Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE
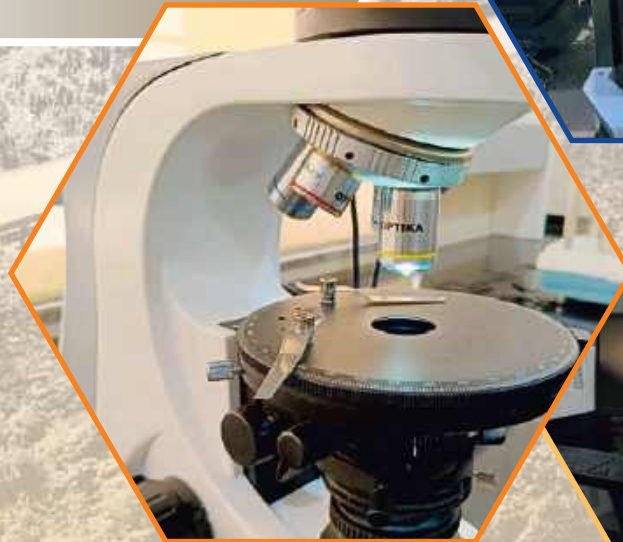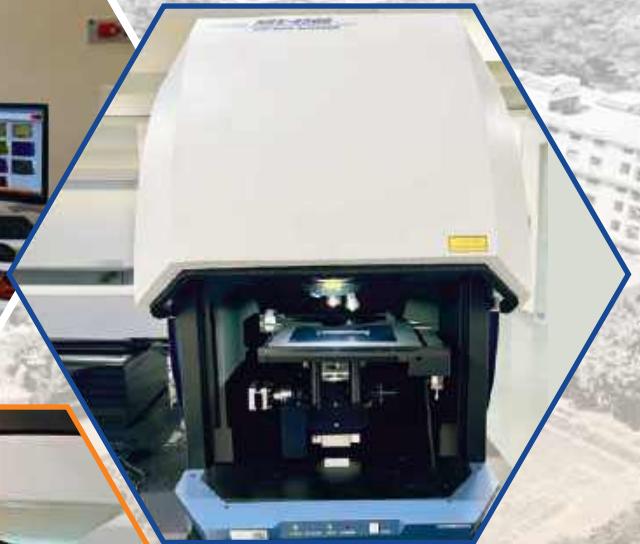TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

CENTRAL RESEARCH FACILITY

Breaking boundaries,
elevating research culture

₹ 140 +M
Research Grants
Received

6000 +
Research
Publications

100 +
Books
Published

170 +
Patents
Granted

250 +
Patents
Published

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ABOUT MIT-WPU

Dr. Vishwanath Karad MIT World Peace University (MIT-WPU), located in Pune, is a prestigious world-class private University in India, boasting a remarkable **40-year legacy** dedicated to fostering excellence in academics and research. With a global alumni network comprising over **1,00,000 professionals**, MIT-WPU has consistently delivered outstanding educational outcomes. The institution offers over 150 undergraduate and postgraduate programs that are thoughtfully designed to strike a balance between theoretical foundations and practical applications.

MIT-WPU, with its robust and enduring research infrastructure, has evolved into an institution of unique scholarly excellence and distinct academic character that inspires and nurtures cross-disciplinary research, encouraging discoveries that have a global impact. MIT-WPU has a stronghold both in academic teaching and research of engineering, physical, chemical, and life sciences, as well as in other disciplines. MIT-WPU has more than **900+ teaching faculty members**, **26000+ students** among them **6700+ students of B. Tech.**, **940+ students of M. Tech. Programs** and around **650+ students do their doctoral research**.

The University has created excellent facilities and ambience for research in various emerging areas. It has sponsored research projects and consultancies from national/international funding agencies, research organizations and Industry.

About Central Research Facility

The University has established a state-of-the-art Central Research Facility (CRF) designed to support advanced research, innovation, and interdisciplinary development across science, engineering, and technology domains. This centralized facility brings together a diverse portfolio of high-end analytical, characterization, fabrication, and testing equipment under one roof, enabling faculty, researchers, industry professionals, and students to conduct cutting-edge experimentation with accuracy and efficiency. The CRF houses an extensive suite of world-class instruments, including X-Ray Diffractometer (XRD) for structural analysis of materials, Nano Indenter for precise mechanical characterization, Surface Profilometer for thin-film and surface roughness studies, and Raman Spectroscopy for molecular and vibrational analysis. We also offer specialized facilities such as Coin Cell Fabrication for battery research and RF–DC Sputtering and Thermal E-beam Deposition Systems for thin-film coating and nanomaterial synthesis. Additional advanced tools include UV-Vis, UV-DRS, and UV-NIR spectrometers for optical characterization, Particle Size and Zeta Potential analyzers for colloidal and nanoparticle studies, ICP-MS for trace elemental analysis, and a high-resolution FE-SEM equipped with EDS for nanoscale imaging and elemental mapping.

List of Major Equipment under CRF:

- ICP-MS
- FESEM
- XRD
- Raman Spectrometer
- Particle/Zeta Size Analyser
- Nanoindenter
- Surface Profiler
- Tribometer
- Polarizing Optical Microscope
- Battery Fabrication System
- UV-Visible and UV-Visible DRS
- UV-VIS-NIR Spectrophotometer

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

Make: **SHIMADZU | Model: ICPMS-2040 LF**

About Instrument: An ICP-MS consists of the ion source, a mass spectrometer – usually a scanning quadrupole mass filter, and a detector. The ICP is at atmospheric pressure, while the MS and detector operate in a vacuum chamber, so an ICP-MS also requires a vacuum pump, a vacuum interface, and some electrostatic ion lenses to focus the ions through the system. ICP-MS uses an argon (Ar) plasma to convert the sample into ions that are then measured using a mass spectrometer. It can be used to measure elements at trace levels in biological fluids.

Specifications/Features:
- Achieves high-sensitivity measurements with a significantly lower argon gas consumption of 11 L/min compared to traditional torches
- Delivers enhanced resolution, enabling half-mass correction for doubly charged interferences
- Works in conjunction with the gas controller and proactive rinsing to reduce measurement times and enhance signal stability
- Reduces argon consumption during standby by lowering gas use to 5.5 L/min
- Reliably generate a robust plasma using low-purity (99.95 %) argon gas, reducing costs
- These features significantly reduce measurement times by efficiently rinsing the sample introduction system and purging the cell
- A single-window interface that simplifies operation and provides advanced features for experienced users

Test and Characterization:
- For identifying and quantifying elements and their isotopes at trace and ultra-trace levels by ionizing samples in a high-temperature argon plasma and separating the ions by their mass-to-charge ratio.
- The process involves aerosolizing a liquid sample, introducing it into the plasma, extracting ions into a mass spectrometer, and detecting them to determine elemental concentrations.

Advantages:
- Trace analysis with excellent limits of detection (ppt).
- Multi-element method for concurrent determination of virtually all elements of the periodic table.
- Dynamic measuring range of over eight orders of magnitude.
- Rapid, semi-quantitative analysis with high informative value for preliminary overviews.
- Can determine isotopic ratios and of isotope dilution analysis.
- Liquid and solid can be analysed with the correct sample introduction/preparation for analysis.

Field Emission Scanning Electron Microscope (FESEM)

Make: TESCAN | Model: S8152

About Instrument: The FESEM is a high-resolution electron microscope designed for detailed imaging and analysis of material surfaces. It provides exceptional surface topography, morphology, and compositional information at the nanoscale, making it an indispensable tool for research, industrial, and educational applications.

Specifications/Features:
- High-resolution imaging up to the sub-nanometre scale
- Electron Source: Field Emission Gun (FEG) for superior clarity
- Accelerating Voltage: 50 eV–30 kV, suitable for delicate and conductive samples
- Detectors: Secondary Electron Detector (SED), In-Beam Detector, Axial Multi Detector (MD) and Backscattered Electron Detector (BSED)
- Modes: Conventional, UH-Resolution, Wide field
- Magnification Range: 10X to 1,000,000X
- Vacuum System: High-vacuum and low-vacuum modes for various sample types
- In chamber plasma cleaner
- In chamber infrared camera

Test and Characterization:
- Surface Morphology and Microstructure Analysis
- Particle size and shape characterization
- Fracture and defect analysis
- Coating, thin films, and nanostructure characterization
- Elemental mapping
- High-resolution imaging of biological and inorganic materials
-

Advantages:
- Ultra-high-resolution imaging for nanoscale analysis
- Versatile for both conductive and non-conductive samples
- Fast and precise imaging with advanced software
- Non-destructive analysis preserving sample integrity
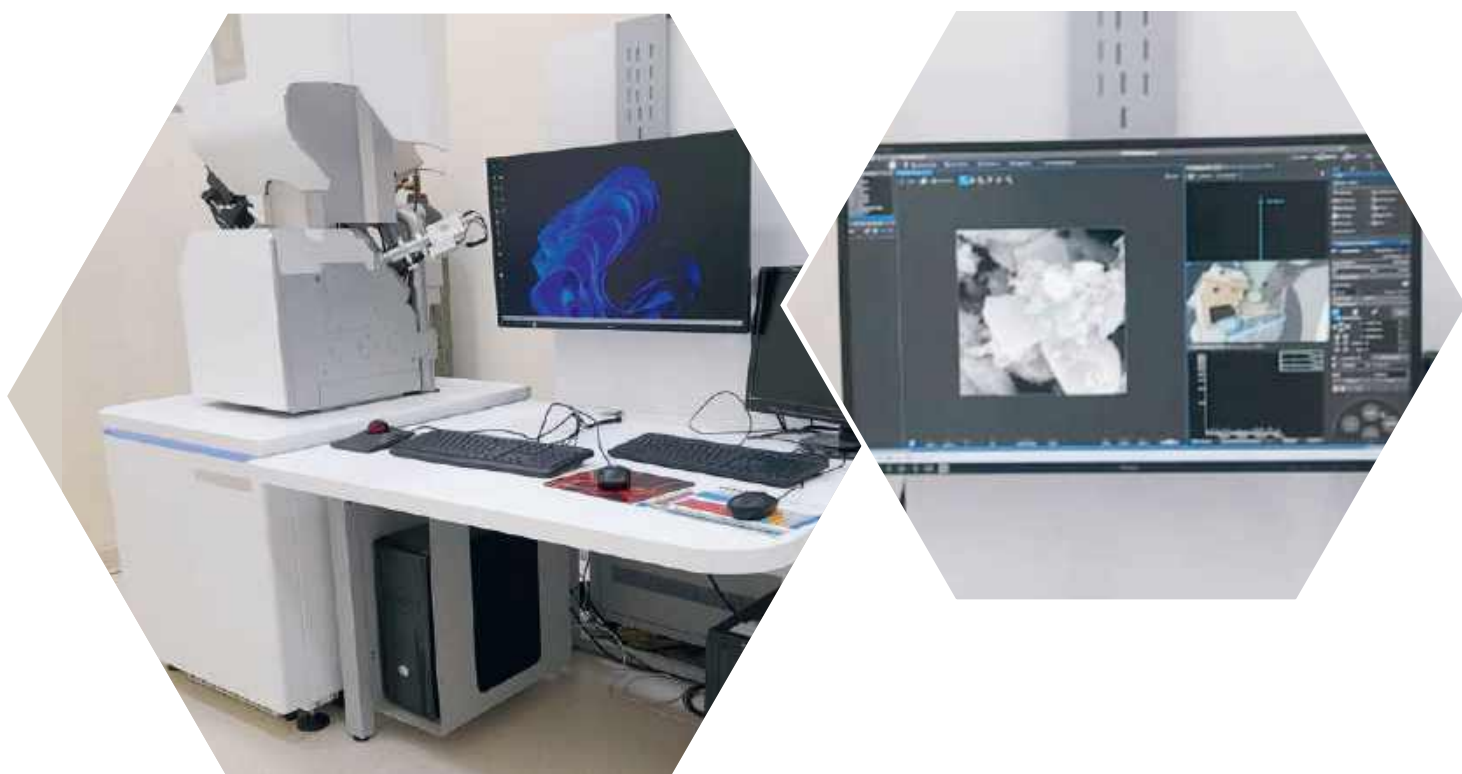
X-Ray Diffractometer (XRD)

Make: **MALVERN PANALYTICAL | Model: Empyrean-DY3280**

About Instrument: XRD is analytical technique used to analyse physical properties such as phase composition, crystal structure and orientation of powder, and solid samples. Many materials are made up of tiny crystallites. The chemical composition and structural type of these crystals is called their phase. Materials can be single-phase or multiphase mixtures and may contain crystalline and non-crystalline components. In an X-ray diffractometer, different crystalline phases give different diffraction patterns. Phase identification can be performed by comparing X-ray diffraction patterns obtained from unknown samples to patterns in reference databases. X-ray diffraction is mainly used to obtain structural information about crystalline solids. Most useful in the characterisation of crystalline materials; ceramics, metals, intermetallics, minerals, inorganic compounds

Specifications/Features:
- Detector - 1Der detector
- Goniometer Configuration - Vertical goniometer
- GIXRD

Test and Characterization:
- Powder and thin film samples can be characterized

Advantages:
- Fast identification of materials
- Easy sample preparation
- Computer-aided material identification
- Large library of known crystalline structures

Raman Spectrometer

Make: JASCO | Model: NRS-4500

About Instrument: A confocal micro-Raman imaging and spectroscopy system, integrating advanced microscopy and Raman spectroscopy within a single platform. It features fully automated switching and alignment of optics, lasers, and filters, ensuring ease of operation and precision in measurements. This versatile instrument is ideal for both routine and advanced Raman applications, serving effectively in quality control, quality assurance, as well as academic and industrial research environments.

Specifications/Features:
- Excitation Lasers: Standard 532 nm and 785 nm
- Maximum Number of Lasers: 2
- Wavenumber Range (Raman Shift): Standard 50 to 8,000 cm⁻
- Spectral Resolution: ~1 cm⁻ with 1,800 gr/mm grating
- Detector: Peltier-cooled CCD (1024 × 255 pixels)
- Microscope/Optics: Built-in CMOS sample viewing camera
- Objectives: Standard 5×, 20×, 100×
- Confocal Optics Standard: Features like Dual Spatial Filter (DSF), Spatial Resolution Image (SRI) built into design

Test and Characterization:
- Raman spectral measurement of molecular vibrational modes (Qualitative and Quantitative)
- Material identification through fingerprint region and functional group analysis
- Chemical mapping and imaging (2D/3D Raman images showing spatial distribution of compounds)
- Depth profiling via confocal optics (z-axis information)
- Stress, strain, and crystallinity analysis in solid samples
- Polymorphism and phase identification in pharmaceuticals and polymers
- Characterization of Carbon Materials: Graphene, CNTs, Diamond-Like Carbon, Graphite, DLC Films
- Semiconductor/Electronics: impurity mapping, doping, heterostructures, defect analysis
- Composite materials, blends, interfaces, coatings
- Analysis under controlled environments or stimuli for e.g. temperature, gas, humidity
- Fluorescence correction/suppression via software (to allow clean Raman extraction)
- Ultra-high-resolution imaging for nanoscale analysis
- Versatile for both conductive and non-conductive samples
- Fast and precise imaging with advanced software
- Non-destructive analysis preserving sample integrity

Advantages:

- Fully automated optical switching, alignment and parameter setup reduces operator burden and error.
- Broad wavelength flexibility allows optimization to sample (optimize signal, minimize fluorescence).
- High spectral resolution and sensitive detector options allow detection of weak Raman signals.
- Confocal optics and fine spatial resolution enable mapping and profiling in 3D.
- Imaging software support (Spectra Manager with mapping, PCA, Peak mapping, 3D images).
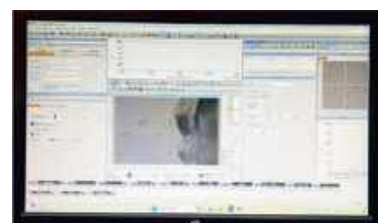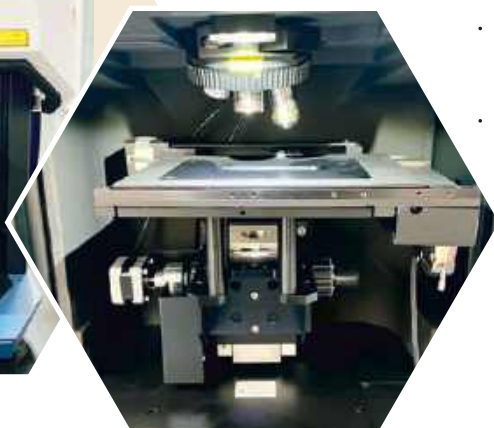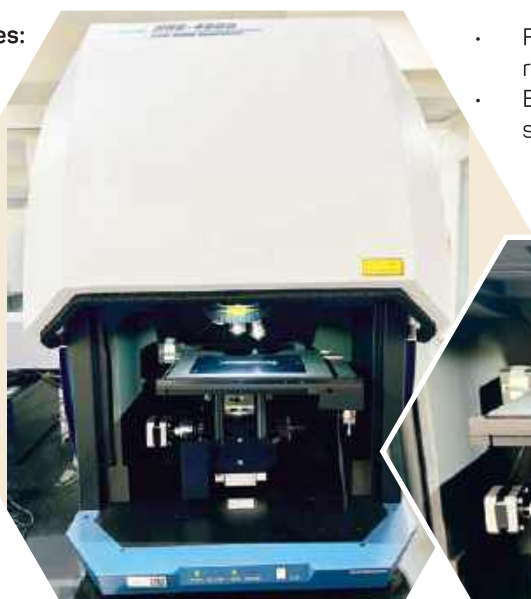
Particle / Zeta Size Analyser

Make: MALVERN PANALYTICAL | Model: Zetasizer Advance (Malvern Light Scattering Technology)

About Instrument: This is a state-of-the-art light scattering instrument designed for precise characterization of nanoparticles and colloidal systems in terms of particle size, zeta potential, and molecular weight using dynamic and electrophoretic light scattering technologies. It is widely used in nanomaterial research, pharmaceuticals, biotechnology, polymers, and colloid chemistry for rapid, high-resolution analysis.

Specifications/Features:
- Measures Particle Size Range: 0.3 nm to 10 µm
- Zeta Potential Measurement Range: 3.8 nm to 100 µm
- Minimum Sample Volume: 3–12 µL (depending on measurement type/model)
- Measurement Techniques:
  - Dynamic Light Scattering (DLS)
  - Electrophoretic Light Scattering (ELS)
  - Multi-Angle Dynamic Light Scattering
- Laser power: 4 mW (Blue label model); 10 mW (Red label model)
- Non-Invasive Backscatter (NIBS) optics for high sensitivity
- Temperature control and compatibility with titrators for automated pH measurements
- ISO Compliance: ISO 13321 & ISO 22412
- Deep learning-based data quality advice and guided workflows using ZS Xplorer software.

Test and Characterization:
- Particle size distribution in suspensions and solutions
- Zeta potential (surface charge) of nanoparticles, colloids, and biomolecules
- Molecular weight determination
- Protein mobility and colloidal stability assessment
- Aggregation detection in protein/antibody formulations
- Particle concentration and polydispersity index
- Characterization of exosomes, liposomes, micelles, viruses, VLPs, cells, yeast lysis products, polymers, and nanocomposites

Advantages:
- High sensitivity and wide dynamic range for nano to micro particles
- Extremely low sample volume needed (as little as 3 µL)
- Rapid data acquisition with patented adaptive correlation and robust repeatability

Nanoindenter

Make: INDUSTRON | Model: NG-80

About Instrument: This instrument probes nanomechanical properties of materials (bulk, coatings, thin films, and polymers) such as elastic modulus, hardness, and fracture toughness.

**Specifications/Features:**
- Maximum Load   : 10 mN
- Load Resolution   : 5 nN
- Displacement Resolution : 1 nm
- Experiments can be performed either in load controlled or in displacement controlled mode.

Test and Characterization:
- All the materials (metals, polymers, ceramics, coatings, and thin films) provided that the surface should be maintained less than 250 nm

Advantages:
- Nanohardness
- Elastic Modulus
- Fracture toughness at nano scale
- Useful for probing micro and nanoscale plasticity in materials
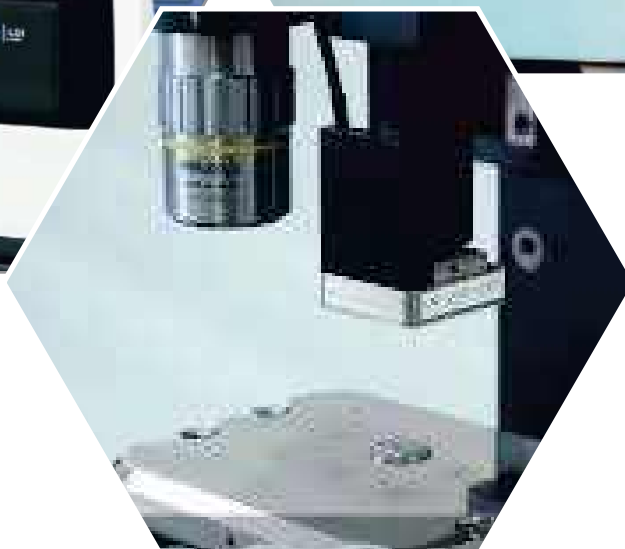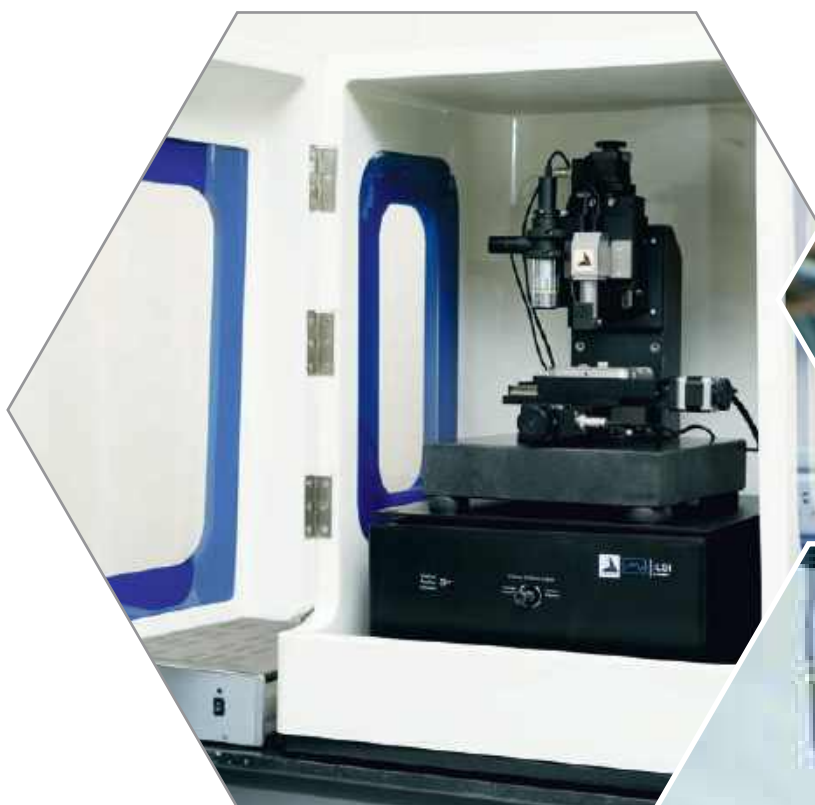
Surface Profiler

Make: BRUKER | Model: Dektak Pro

About Instrument: This instrument probes quality and integrity of surface of materials (bulk, coatings, thin films, and polymers) reflecting average surface roughness, peak to valley profiles, average surface height, and thickness and residual stresses in the thin films.

Specifications/Features:
- Maximum Load : 6 mg
- Maximum Scan Length : 3000 μm

Test and Characterization:
- All the materials (metals, polymers, ceramics, coatings, and thin films) provided that the surface should be maintained less than 1 mm
- It can perform measurements on the surface of the samples such as surface roughness, thickness of thin film, and residual stresses in thin films

Advantages:
- For small size samples to probe the integrity of the surface at micron and nano scale
- Measuring the residual stresses in thin films

Tribometer

Make: **DUCOM | Model: POD-4.0**

About Instrument: Tribometer is the instrument that characterizes tribological and wear behavior of materials (bulk, coatings, and polymer coatings on stiff substrate) reflecting frictional force, wear morphology, and coefficient of friction.

Specifications/Features: ·   Pin-On-Disc Tribometer (Counter Material is Stainless Steel Balls)
    ·   Environment: Room and High Temperature (upto 900 °C)
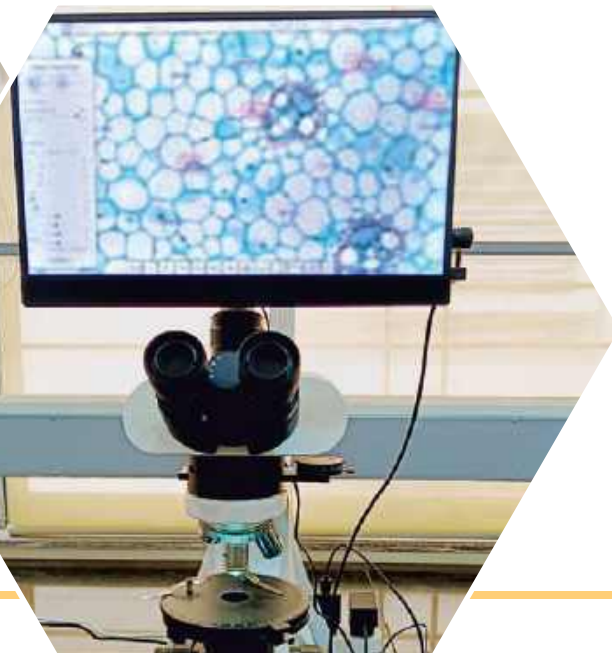   ·   Maximum Sample Size: Diameter 60 mm for rotary motion with a thickness of 2 mm

Test and Characterization: ·   Metals and coatings deposited on stiffer substrate
    ·   Estimate coefficient of friction and frictional force
    ·   Reciprocatory as well as rotary wear

Advantages: ·   Can perform the wear experiments from room to high temperature (upto 900 °C)
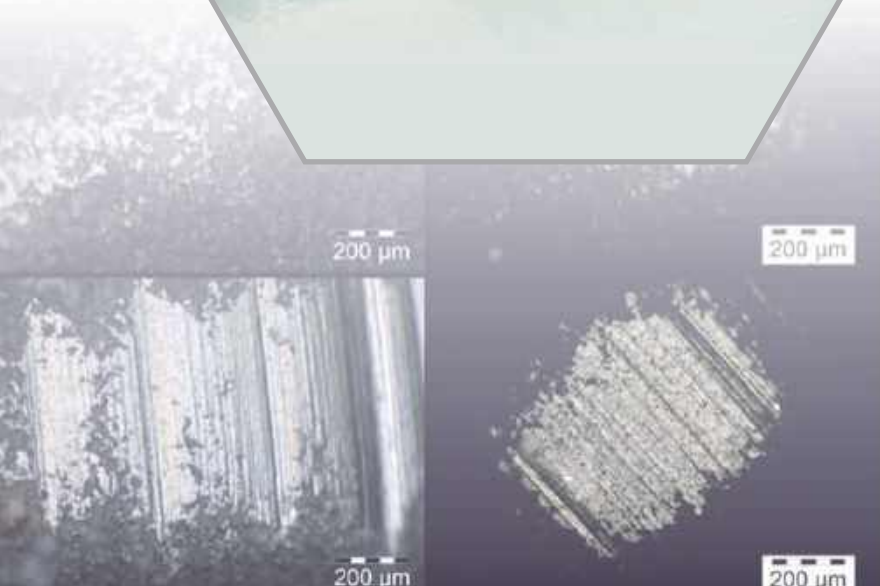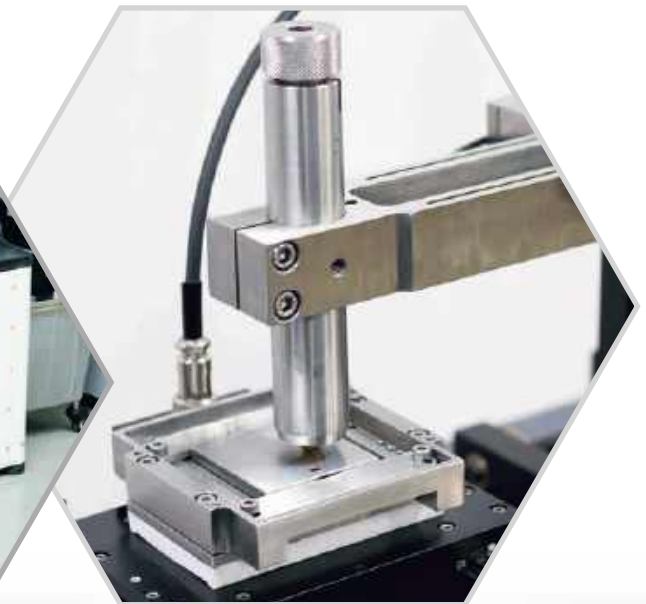
Polarizing Optical Microscope

Make: OPTIKA | Model: B-510POL

About Instrument: This instrument provides comprehensive optical microscopy analysis of anisotropic and transparent materials such as liquid crystals, polymers and thin film applications. The microscope delivers high-contrast images with polarized light, permitting the easy discernment of birefringence, defect orientations and surface morphology. The instrument includes advanced illumination and imaging functions capable of supporting both qualitative and quantitative studies.

Specifications/Features:
- Equipped with a 3.6 W LED Kohler illumination system with adjustable field diaphragm for uniform lighting
- Observation Modes: Brightfield and transmitted polarization
- 360° rotatable stage with vernier scale accuracy of 0.1 mm, featuring a specimen slide clamp for precise alignment
- High eyepoint eyepieces, one fitted with a crosshair reticle for accurate optical centering
- Long working distance objectives offering 4x, 10x, 20x, and 40x magnifications
- Rotatable analyzer (0°–90°) with a graduated scale for polarization angle control
- Integrated LCD panel display for real-time visualization, image capture, and video recording
- Supports data storage on an SD card and direct transfer to PC for analysis and documentation

Test and Characterization:
- Characterization of transparent films to analyze surface morphology and texture
- Study of tilt and pretilt angles in light-sensitive materials such as liquid crystals
- Examination of defects, disclinations, and light leakage centers in anisotropic samples
- Visualization of domain boundaries, grain structures, and orientation variations in polycrystalline materials

Advantages:
- Delivers contrasting polarized imaging for precise studies of optical anisotropy
- Supports accurate sample rotation and measurements via the use of 360° rotatable stage with a vernier scale
- Digital imaging capability with integrated LCD screen allows easy photo/video documentation and data storage
- Ideal for academic research and materials science and liquid crystal studies requiring precision and repeatability

Battery Fabrication System

Make: TESCAN | Model: S8152

About Instrument: We have a complete coin-cell battery fabrication facility equipped with a spacious, well-ventilated laboratory designed to support an efficient and contamination-free workflow. The facility includes:

i. **Slurry Machine:** Ensures homogeneous mixing and dispersion of electrode materials for high-performance battery electrodes.

ii. **Doctor Blade Coating Unit:** Offers precise and reproducible coating of electrode slurries onto aluminum or copper current collectors.

iii. **Vacuum Oven:** Enables uniform drying and efficient removal of moisture and solvents from coated electrodes under vacuum.

iv. **Calendering Machine:** Delivers uniform and adjustable compaction of electrode sheets for optimal thickness and density control in battery manufacturing.

v. **Electrode Punching Machine:** Ensures accurate disc punching with consistent diameter, improving cell-to-cell reproducibility.

vi. **Glove Box System:**
- Enables safe and controlled handling of air-sensitive battery materials in an inert atmosphere (Ar).
- Maintains an ultra-pure inert atmosphere (<0.01 ppm H_2O and O_2) using a high-efficiency gas purification system with continuous circulation.
- Fabricate half and full coin cells (CR 2032) for both lithium and sodium-ion batteries with complete safety and precision, all in one state-of-the-art workstation.

vii. **Battery Tester (Multi-Channel):** Provides accurate charge-discharge cycling, rate capability evaluation, coulombic efficiency measurement, and long-term electrochemical performance testing of assembled coin cells under controlled conditions.
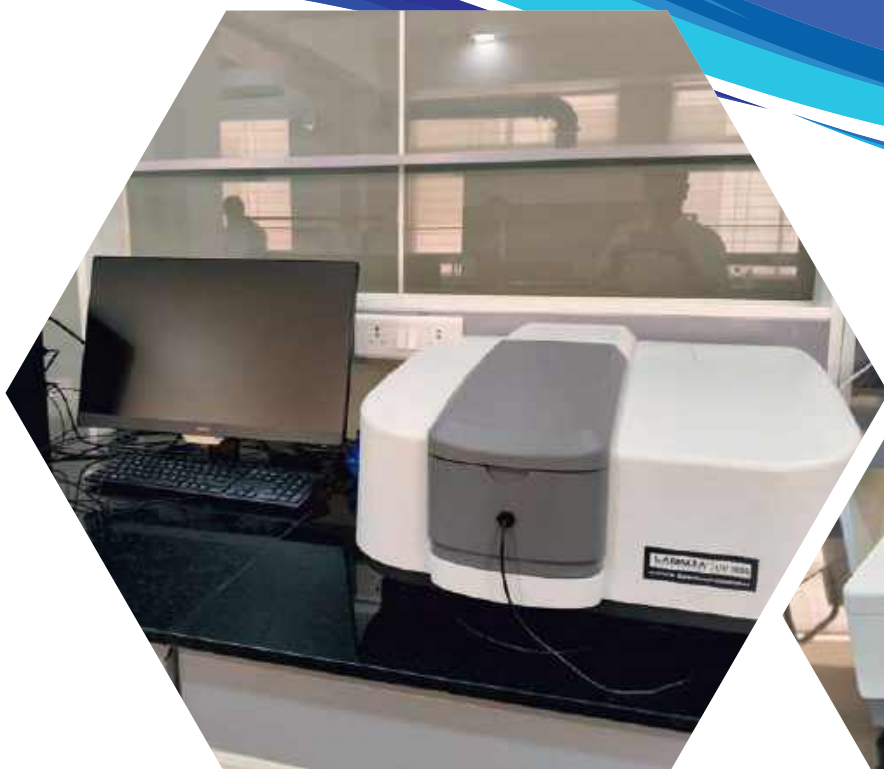
UV-Visible and UV-Visible DRS

Make: LABINDIA | Model: UV 3200 and UV 3092

About Instrument: Advanced, research-grade analytical instrument designed for comprehensive material characterization. It functions as a high-performance double-beam UV-Visible spectrophotometer for liquid analysis and is equipped with a precision Diffuse Reflectance Spectroscopy (DRS) accessory for analysing solid, opaque, or powdered samples. This dual-capability makes it the ultimate tool for R&D and QC in fields like polymer chemistry, materials science, and coatings.

Specifications/Features:
- Light Source   : A high-stability, auto-switching dual-lamp system
- Deuterium (D2) Lamp   : For the ultraviolet (UV) range (190 nm - 350 nm)
- Tungsten-Halogen Lamp : For the visible (Vis) and near-infrared (NIR) range (350 nm - 800 nm)

Test and Characterization:
- Transmission/Absorbance Module (for Liquids)
- Diffuse Reflectance Spectroscopy (DRS) Module (for Solids/Powders)

Advantages:
- Photoinitiator Identification & Quantification, Kinetic curing Study
- UV blocker analysis
- Colorimetric analysis of cured parts
- Optical band gap energy calculation
- Degradation and stability studies

UV-VIS-NIR Spectrophotometer

Make: SHIMADZU | Model: UV-3600i Plus UV-VIS-NIR SPECTROPHOTOMETER

About Instrument: This equipment is a research-grade, double-beam spectrophotometer renowned for its exceptionally wide wavelength range, covering the ultraviolet (UV), visible (Vis), and near-infrared (NIR) regions. Its unique three-detector system ensures unparalleled sensitivity and accuracy across the entire spectrum, making it a benchmark instrument for advanced materials science, optics, life sciences, and chemical analysis.

Specifications/Features:
- Wavelength Range : 185 nm to 3,300 nm
- Spectral Bandwidth: UV/Vis : 0.1 to 8 nm; NIR: 0.2 to 32 nm
- Stray Light : < 0.00005 % (at 220 nm) (Ultra-low)
- Wavelength Accuracy : ± 0.08 nm (UV/Vis); ± 0.3 nm (NIR)
- Photometric Range : -8 to 8 Absorbance Units
- Baseline Stability : < ± 0.0003 Abs/hour
- Detectors : PMT (UV-Vis), InGaAs (NIR), Cooled PbS (NIR)
- Sample Compartment Size : 150W x 260D x 140H mm

Test and Characterization:
- Calculating the optical band gap energy of materials using reflectance data (with an integrating sphere) and a Tauc plot
- Characterizing anti-reflection (AR) coatings, low-emissivity (Low-E) glass, and optical filters by measuring transmittance and reflectance from UV to NIR
- Identifying polymer types, quantifying additives (like UV blockers), and studying material degradation or yellowing
- Characterizing the transmission properties of lenses, optical fibers, and communication components, especially in the NIR telecom wavelengths (1300-1600 nm).
- Analyzing impurities in organic solvents and measuring the water content in various samples using specific NIR absorption bands.
- Non-invasive analysis of biological components like haemoglobin, lipids, and water content in tissues using the NIR region.

Advantages:
- Wavelength Range: 185 to 3,300 nm
- Exceptional Sensitivity Across the Board
- Ultra-Low Stray Light
- Maximum Versatility
- Reliability
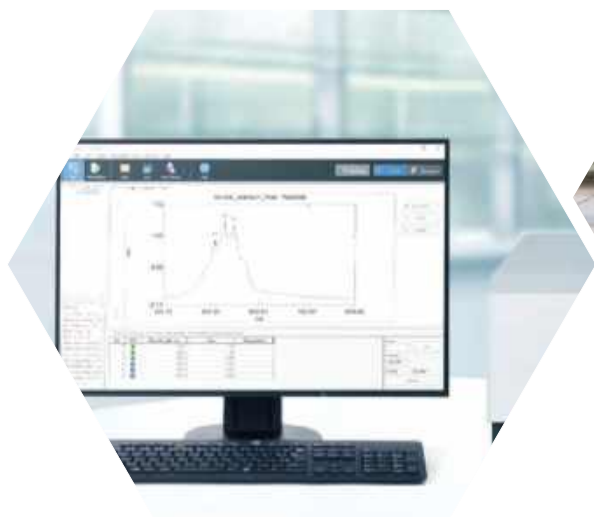
Other NABL Accredited with the standard ISO/IEC 17025:2017 Equipment Available:	
Name of the Equipment	**Standard**
Universal Testing Machine (0 to 100 kN)	IS 1608 (Part 1) ASTM E8/E8M ASTM D3039/D3039M
Hardness Testing Machine - Rockwell	IS 1586 (Part 1)
Hardness Testing Machine Vickers/Brinell	IS 1500 (Part 1)
Hardness Testing Machine - Micro-Vickers	IS 1501 (Part 1) & ISO 6507-1
Universal Testing Machine (0 to 5 kN)	ASTM E345
Microscope RV 3	ASTM E112
Axial Computerized Fatigue Test Machine	ASTM D3479 & ASTM D3479M
Compression Testing Machine	IS 516 (Part 1/Sec 1)
Universal Testing Machine (0 to 1000 kN)	IS 1608 (Part 1)