The Micro & Nano Characterization Facility (MNCF) is a fully-staffed, user research facility at Indian Institute of Science (IISc) that offers research convenient and reasonably priced access to a wide range of state-of-the-art analytical instruments & services. The MNCF is a 5000 sqft precision controlled environment facility housing four distinct laboratories for Electrical, Mechanical, Optical, & material characterization. It is a national facility housing a plethora of high-end equipment spanning over multiple disciplines of Nano Science & Engineering rarely found under a single roof.
Electrical Characterization

**IV, Pulse IV & Impedance Measurements:**
- Single setup for Complete Electrical characterization for CMOS, MEMS devices.
  - Multi 6 wafer prober are coupled with wide range of precise measuring equipment with variation in parameters like temperature, which covers immensely wide electrical domain.
  - Facilities for accurate fast IV and time-domain measurement for a wide range of applications such as pulsed IV, NBI, and RTS measurement.
  - IV setup supports high resolution current-voltage (IV) measurement to 0.1% and 0.5% resolution without averaging.
  - Pulse IV setup facility is equipped with system which integrates arbitrary linear waveform generation capability with high-speed IV measurement. Given tool it is possible to generate not only DC, but also various types of AC waveforms such as pulses, staircase sweeps, and staircase pulsed sweeps with 10 ns programmable resolution.
  - Arbitrary linear waveform generation (ALWG) feature supports the creation of both DC and complex AC waveforms.
  - Capable of Impedance measurements covering wide frequency domain from 40Hz to 110MHz.
  - Supports both quasi-static and medium-frequency capacitance-voltage (CV) measurement with Multi frequency capacitance measurement ranging from 1 Hz to 5 MHz with option of listing 21 frequencies in one run.
  - Supports accurate fast IV and time-domain measurement for a wide range of applications.
  - Supports high voltage pulse generation (up to ±40 V) for high power and memory device testing.
  - Each station has 4 SMU (Source Monitor Units), 2VSU (Voltage Source Units) and 2VMU (Voltage Monitor Units).
  - Precise measurements of parameters like Z' (impedance), Z'' (admittance), q (phase), R (resistance), X (reactance), G (conductance), B (susceptance), L (inductance), C (capacitance), Q (quality factor), D (dissipation factor), ESR (equivalent series resistance) and Rp (parallel resistance).
  - Impedance measurement range covers from 10 mΩ to 200 MΩ (typical).
  - Hall mobility measurements setup also available.
  - More than 500 application files with various parameters extraction possible.
  - Arrangement for capturing image & video during mearements.

**RF Measurements:**
- S-Parameter measurements up to 67GHz
  - Cascade Microtech Summit 9000 Probe station interfaced with Agilent B8361A Performance Network Analyzer.
  - Upto 6 inch wafers, Leica S6E microscope to view the surface.
  - Contact substrate for probe alignment and Impedance Standard Substrate (ISS) for the probe calibration.
  - 94 dB of dynamic range and <0.006 dB trace noise (specified to 67 GHz).
  - With operation to 70 GHz, 26 usec/poin measurement speed, 32 channels.
  - 16,001 points, TRL/LRM calibration, on-wafer, in-fixture, waveguide, and antenna measurements.
  - Mixer conversion loss, return loss, isolation, and absolute group delay, Amplifier gain compression, harmonic, IMD, and pulsed-RF.

**Mechanical Characterization**

**Micro System Analyzer**
- One stop solution for all your MEMS device characterization requirements.
  - Full-field vibration mapping and broadband, out-of-plane frequency response information, High density sample grids with up to 512 x 512 user-defined measurement points.
  - Submicron laser probe spot for measuring very small structures and details.
  - Stroboscopic Video Microscopy for In-Plane Motion Detection, detection up to 1 MHz.
  - Time-domain displacement measurements with nanometer resolution.
  - White Light Interferometry for the Acquisition of Topography Data.
  - Rapid, non-contact 3-D topography measurement with sub-nanometer Resolution.

**Bruker AFM & Agilent 500 AFM**
- Classic AFM imaging and other cutting edge modes for thorough atomic scale characterization.

**Scanning Acoustic Microscopy**
- Non destructive high resolution sub-layer ultrasonic imaging.
  - Available transducer: -50, 100, 150, 230 MHz.
  - Scanning modes: A, B, C, D, 3D, sequence, auto, profile) and X-scan.
  - HQ, FFT, B-scan with quantitative measurement.
  - Material spectroscopy through acoustic impedance analysis.
  - Maximum scan area 400X400mm.

**Non contact optical profiler**
- Sub-nanometric 3D non contact profiling for in-depth surface morphology analysis.
  - For the measurement of non-contact surface roughness, step-heights, form, shape, angular and critical dimension results. The TalySurf CCI is an advanced 3-dimensional non-contact optical metrology tool used for advanced surface characterization. These instruments have the ability to offer a true topographical representation of a surface with 0.01 nm Z resolution over full scan range plus a 0.4 nm lateral resolution, with over 1,000,000 data points.
  - All material types are measurable including: glass, liquid inks, photo resist, metal, polymer and pastes.
  - Advanced optical interferometry.
  - 2.2 mm ver tical range with closed loop piezoeless Z axis scanner.
  - New improved X, Y and Z stitching, up to 100 mm measurement range.
  - 1048 x 1048 pixel array for large FOV with high resolution.
  - Increased angle sensitivity giving better data quality.
  - Virtual elimination of measurement uncertainty.
  - <0.2 Angstrom RMS repeatability, <0.1% step height repeatability.
  - 0.1 Angstrom resolution over the entire measurement range.
  - FEA optimised mechanical design for excellent R&R capability.
  - Calibration utilizing ISO standards ensures acceptance of results.

**Micro UTM**
- Strength of material analysis down to the micron scale.
  - Studies like Tensile, strain measurements can be done over wide range.
  - Of fields, few like mentioned below :-
**Optical Characterization**

**Raman and MicroPL System**
- Fast, non-destructive chemical analysis of solids, powders, liquids, and gases
  - High spectral resolution of 0.3 cm⁻¹
  - High spatial resolution of 1 μm, integrated confocal microscope
  - Multiple laser coupling: 325nm and 514.5nm
  - Non-reflective black finish reduces stray light
  - Improved optical design for maximum spatial uniformity
  - Improved working distances accommodate larger samples
  - Fast, non-destructive chemical analysis of solids, powders, liquids, and gases

**Solar Simulator**
- Solves all your solar cell characterization requirements!
  - Output beam sizes 2x2", 4x4", 6x6", 8x8", and 12 x 12"
  - Factory certified Class AAA CW systems
  - Calibration certificate validating Class AAA performance for all standards: EC ASTM and IEC
  - Long-lived, highly reliable instruments designed specifically for 24/7 production environments
  - Temperature sensor and interlock ensure operator safety

**FT/IR**
- FT-IR Spectrometers for measuring all IR frequencies simultaneously presenting the desired spectral information for analysis.
  - Dynamic Alignment ensuring exceptional high-resolution line shape, USB 2.0 interface

**SPM-NSOM**
- Powerful tool capable of simultaneous AFM-NSOM and many other scanning modes
  - Independent scanning of up to four probes for atomic force, near-field optical and probes for scanned probe imaging modes
  - Unique probes for multiple probe resistance measurements with two, three and four point probe geometries
  - Unique thermal probes for multiple probe measurements

**Materials Characterization**

**SEM with EDS and MonoCl**
- High resolution scanning electron imaging coupled with material spectroscopy tools
  - Fully integrated EDS detector for compositional information
  - Low kV BSE imaging at short working distance: WD = 1 mm
  - Ultra-stable high-beam current for analytical applications up to 100 nA @ 0.2%/h
  - GEMINI technology with high efficiency In-lens detector for high contrast topographic imaging

**ZETA Particle Analyzer**
- Advanced nanoparticle analysis tool
  - Low mobilities measurement, the Brookhaven ZetaPALS is the answer. The coincidence point potential using Phase Analysis Light Scattering: A technique that is up to 1,000 times more sensitive than traditional light scattering methods based on the shifted frequency spectrum. Electrophoretic measurement of colloidal particles is often the key to understanding the stability of any dispersion. A simple, easy measurement of the electrophoretic mobility “even in information. Measurements made in water and other polar liquids are easy and fast with the Brookhaven ZetaPlus. Such measurements cover the range of typically mobilities of ± 0.5-8x10⁻⁸ m²/Vs.
  - Zeta Potential: Size range suitable for measurement 1 nm to 100 nm
  - Mobility range: 10⁻¹¹ to 10⁻⁷ m²/Vs
  - Zeta potential range: -220 mV to 220 mV (*)
  - Maximum sample concentration: 10% w/w (*)
  - Sample volume: 180 L, 600 L, 1250 L
  - Maximum sample conductivity: 30 S/m
  - Signal processing: Phase Analysis Light Scattering, PALS
  - Particle size: Size range (radius) <0.3 nm to >3 microns (*)
  - Sample volume: 10 L, 40 L, 1 - 3 mL
  - Concentration range: 0.1 mg/mL to 10% w/w (*)

**XPS**
- Powerful electron and ion beam tool for imaging, patterning and precise TEM sample preparation
  - Electronics3D Metrology
  - Distortion & Failure Analysis
  - TEM Lamella Preparation
  - Materials Science Prototyping for MEMS and NEMS
  - Nanometry of Critical Dimensions at the Nanoscale
  - High Quality Sample Preparation Using Focused Ion Beams
  - Natural Resources/Cutting, Drill Cores, and Plugs
  - Brookhaven XPS tool for materials identification and analysis, and advanced studies
  - Spectroscopy and imaging modes available
  - Exceptional small spot capabilities (15 micron)
  - Charge neutralization feature for insulating samples
  - Quantitative chemical imaging of surfaces