CeNS

Research Facilities
Ready Reckoner

नैनो एवं मृदु पदार्थ विज्ञान केंद्र

CENTRE FOR NANO AND SOFT MATTER SCIENCES

Autonomous Institute under the Dept. of Science and Technology, Govt. of India

Contents

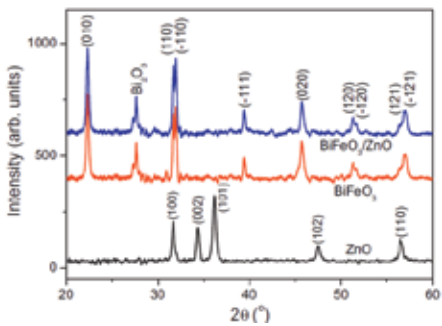
1 X-ray Diffractometer

Rigaku SmartLab, 2012

TECHNICAL AND CHARACTERIZATION DETAILS

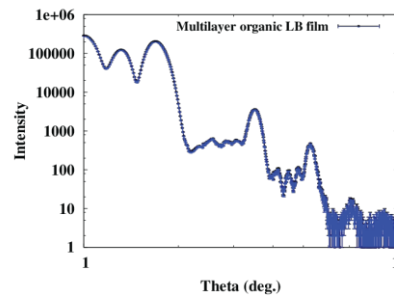
- Powder samples and thin films - Horizontal sample mounting
- Bragg-Brentano (theta-theta) and parallel beam (grazing incidence) geometry
- Cu KAlpha line
- 3 kW X-Ray generator
- Bent/flat switchable receiving graphite monochromator
- Rotating sample plate
- 4" wafer sample plate; maximum thickness-1 mm
- Scanning range: -3 Deg-160 Deg (2theta equivalent)
- Minimum step width-0.0001 Deg.
- Variable slit widths
- Goniometer radius : 300 mm
- Scintillation counter and semiconductor detector
- Rocking curve measurement
- Automatic identification of crystal structure with PDF database
- PDXL software based refinement to obtain lattice parameters, unit cell volume
- Crystallite size and lattice strain analysis
- Global Fit XRR Reflectivity Analysis Software
- Reflectivity analysis- FFT film thickness analysis function, surface & interface roughness, and density analysis function by curve fitting
- Simulation function of reflectivity profile

REPRESENTATIVE ACQUIRED DATA & REFERENCE



XRD from ZnO and BiFeO3 thin films on Si substrate
Mat. Sci. Eng. B, 177, 908 (2012)

Contact: resfac@cens.res.in



X-ray reflectivity data

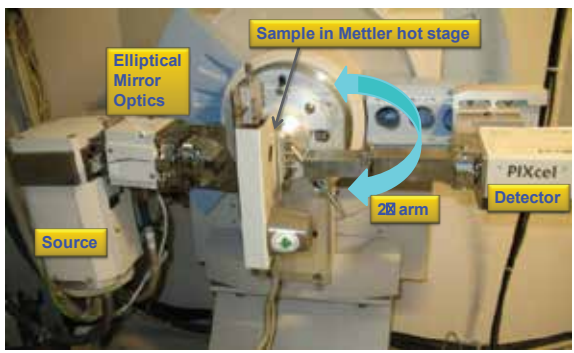
2

X-ray Diffraction System with High Spatial Resolution Fast Detector

Panalytical X'Pert PRO, 2008

TECHNICAL AND CHARACTERIZATION DETAILS

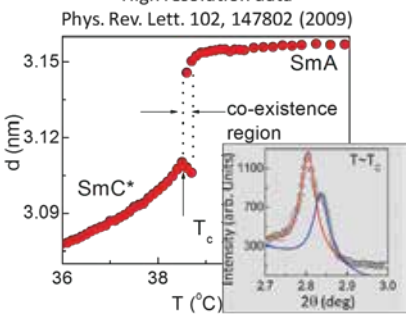
- Capillary samples (ambient and high temperature) and thin films at ambient temperature Horizontal sample mounting
- Transmission and grazing incidence geometries
- 3 kW X-Ray generator
- CuK_{α} line beam with beam preparation optics
- Hybrid monochromator/Focussing Elliptical mirror assembly
- Soller slits before and after the sample for minimization of out-of-plane reflection
- Scanning range: 1 Deg to 140 Deg
- Minimum step width: 0.001 Deg in accumulation mode
- Variable slit widths
- Fast high resolution PIXCEL solid state multichannel detector
- Temperature range: ambient to 250 deg C, 0.1 K resolution using Mettler hot stage
- Rietveld, Stress and line-profile analysis



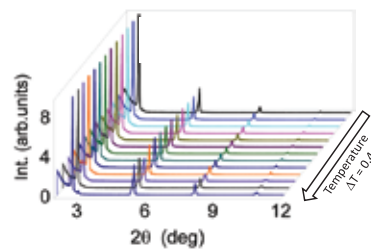
Contact: skprasad@cens.res.in
resfac@cens.res.in

REPRESENTATIVE ACQUIRED DATA & REFERENCE

High resolution data
Phys. Rev. Lett. 102, 147802 (2009)



XRD profiles from the rotator phase of an alkane/liquid crystal composite
Langmuir 30, 4465 (2014)



3

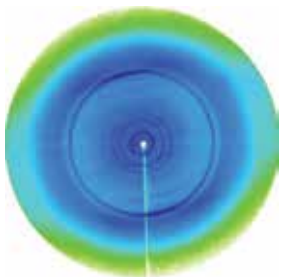
X-ray Diffractometer with 2D Image plate detector

Xenocs GeniX3D, 2013

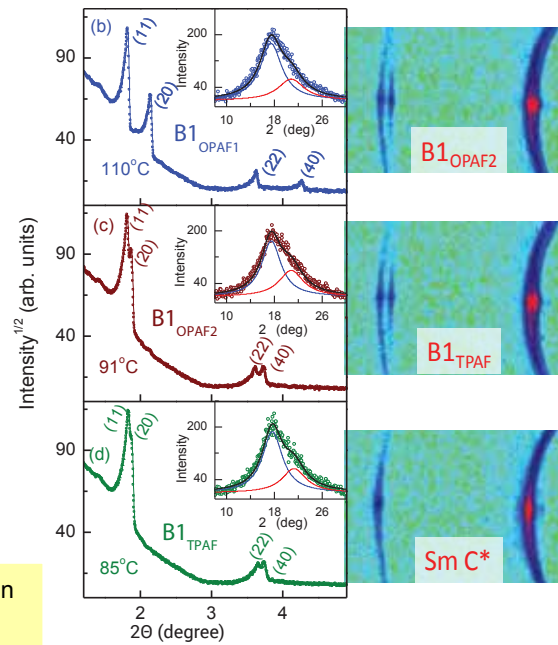
TECHNICAL AND CHARACTERIZATION DETAILS

- Operates at 50 kV and 0.6 mA in conjunction with a single reflection aspheric multilayer optics
- Provides low divergence highly parallel beam with high photon density Cu K_α (λ = 0. 15418 nm) radiation
- Detector : 2D Image Plate λ of 345 mm diameter and 0.1 mm pixel size (Mar345, Mar Research)
- Includes SAXS/ WAXS (~30 nm-0.3 nm)
- Marview, FIT2D software software helps in getting 2D image, 1D profile of the diffraction pattern
- Capillary samples (ambient and high temperature)
- Horizontal sample mounting & Transmission geometries

REPRESENTATIVE ACQUIRED DATA & REFERENCE



XRD pattern of 2D tilted columnar phase



XRD patterns of columnar & layered structures in bent core systems; J. Mater. Chem. C, 1, 7488 (2013)

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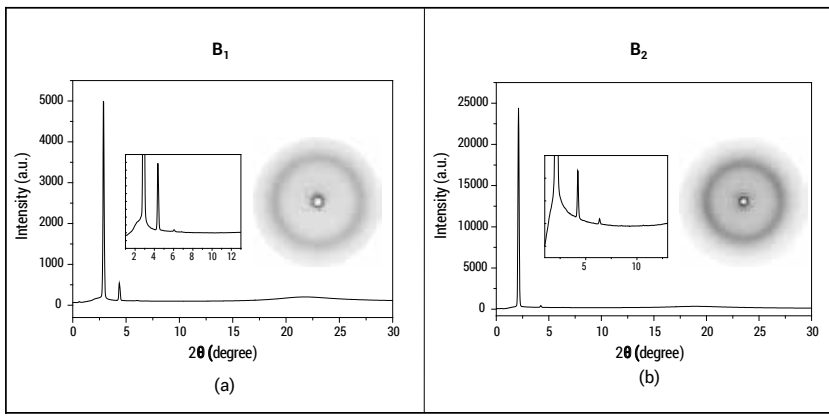
X-ray Diffractometer

Xenocs, Genix Cu MAR345, 2009

TECHNICAL AND CHARACTERIZATION DETAILS

- 8 keV Cu K alpha line
- X-ray beam of 1.5 x 1.5 mm sq. Size
- Shielded microfocus tube
- XYZ translation stage
- Mounting base for detector with rail system
- Bragg and tilt adjustments
- 50 W generator, 50 kV/1 mA
- X-ray CCD camera for optic alignment with an X-ray to visible light converter screen
- PIN Diode detector for optics and beam alignment with calibrated response for absolute flux measurement
- Collimator with 2 transparent screen and 3 pinholes of 0.2 mm, 0.5 mm, 0.8 mm
- Image plate detector and software for data acquisition

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Intensity versus 2θ graph and the XRD patterns (inset: small angle region) obtained for the liquid crystal molecules (a) at 125°C (b) at 145°C.

Liq. Cryst., 40, 1405 (2013).

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5

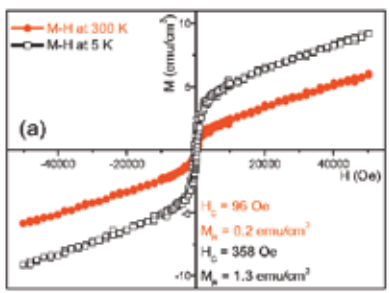
SQUID Magnetometer

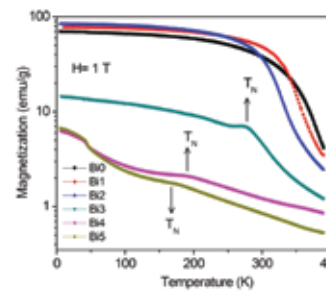
Ever Cool MPMS XL, Quantum Design, 2002

TECHNICAL AND CHARACTERIZATION DETAILS

- M-H, M-T, M-Time and AC susceptibility measurements
- Samples: Nanoparticles, powder, thin films, bulk & liquids
- Sample Size : 4 X 9 mm (W(D) x L)
- Samples are typically 10 to 40 mg, but strongly magnetic materials can be measured with less material
- Magnetic field: +/- 5 T
- Field resolution: 1 Oe
- Field uniformity : 0.01% over 4 cm
- Temperature Range : 10 – 380 K
- Temperature Stability:+/-0.1 K (below 100 K)
- Temperature Stability:+/-0.005 K (above 100 K)
- Sample Space Oven - increases temperature range to 800 K
- Reciprocating Sample Option (RSO) – DC Magnetization absolute sensitivity: < 1 x 10^{-8} emu
- External device control + transport probe
- MPMS MultiVu: Windows based Software Interface - Automated measurements
- M-H can be measured in the field range +/- 5 T at various temperatures from 10 K to 380 K
- M-T can be measured from 10 K to 380 K at different applied fields and under zero field
- AC susceptibility measurement – 0.1 Hz to 1 kHz, sensitivity: 2 x 10^{-8} emu at 0 T

REPRESENTATIVE ACQUIRED DATA & REFERENCE





Temperature dependence of magnetization of $La_{0.67-x}B_{ix}Sr_{0.33}MnO_3$ (x=0, 0.1, 0.2, 0.3, 0.4 and 0.5), i.e., Bi0, Bi1, Bi2, Bi3, Bi4 and Bi5 with applied field of 1 T in field cooling mode.

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angappane@cens.res.in

Enhanced magnetization of $BiFeO_3$ due to ZnO buffer layer ; Mat. Sci. Eng. B, 2012, 177, 908.

6

Semiconductor Characterization System

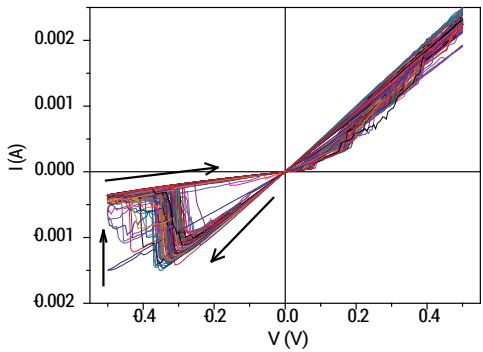
Keithley Model 4200SCS/F Semiconductor Characterization System with 2 MPSMU

- Model 4210- SMU (1 no.) - High Power Source-Measure Unit for 4200-SCS. 1A to 100fA, 200V to 1µV, 20Watt
- Model 4200-PA (3 nos.) - Remote PreAmp Option for 4200-SMU, extends SMU to 0.1fA resolution
- Model 4210- CVU (1 no.) - Integrated C-V Option for Model 4200-SCS.(1kHz to 10MHz)
- Model 4225- PMU (1 no.) - Dual Channel Ultra-Fast IV Unit for 4200-SCS
- Model 4225- RPM (2 nos.) - Single Channel Remote Amplifier and Switch Module Option for 4225-PMU
- Model 8101-PIV (1 no.) - Demo Test Fixture

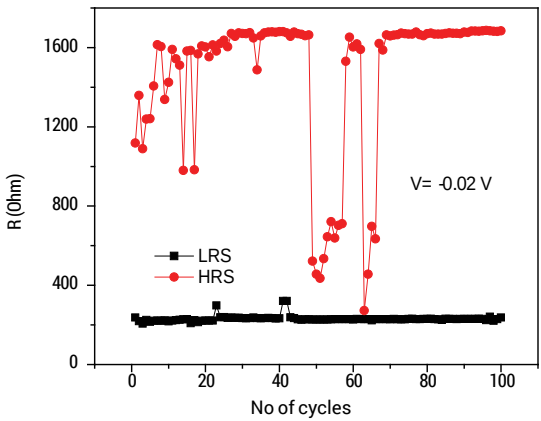
TECHNICAL AND CHARACTERIZATION DETAILS

- Three I-V source-measure channels
  - ¤ Current Range: 1 pA to 1 A
  - ¤ Current Measure Resolution: 100 aA to 1 µA
  - ¤ Current Source Resolution: 1.5 fA to 50 µA
  - ¤ Voltage Range: 200 mV to 200 V;
  - ¤ Voltage Measure Resolution: 1 µV to 200 µV Voltage Source Resolution: 5 µV to 5 mV;
- One multi-frequency CV measurement
  - ¤ Measuring parameters: Cp-G, Cp-D, Cs-Rs, Cs-D, R-jX, Z-θ
  - ¤ Frequency range: 1 kHz to 10 MHz
  - ¤ AC drive level: 10 mV to 100 mV
  - ¤ DC drive level: -30 V to +30 V
  - ¤ Programmable DC output modes: Bias, Sweep, List Sweep
- Pulsed IV measurement channel
  - ¤ Current Measure Range: 100 nA to 200 mA
  - ¤ Pulse Width: 160 ns to 70 ns
  - ¤ Voltage Source (10V) Range: -10 V to +10 V, 50Ω into 1MΩ
  - ¤ Voltage Source (40V) Range: -40 V to +40 V, 50Ω into 50Ω
  - ¤ Resolution: < 250 µV to <750 µV
  - ¤ Frequency Range 1 Hz to 50 MHz
  - ¤ Period Range Accuracy 20 ns to 1s
  - ¤ Maximum current: +/- 0.8 A
  - ¤ Pulse width with current measure: 60 ns to 999 ms
- Switching capability between DC IV, CV and Pulse IV measurements as detailed below
- Project libraries to extract parameters from two terminal, three terminal & four terminal devices

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Resistive switching behaviour of ZnO/Pt/TiO_2/SiO_2/Si.



Retention characteristics of ZnO/Pt/TiO_2/SiO_2/Si.

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7

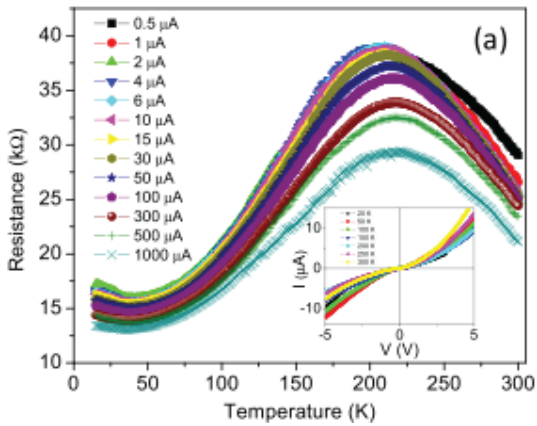
Low Temperature Resistance and Magnetoresistance Measurements

Janis cryostat with Shimotomo He compressor, 2010
Keithley Current Source Model 6221 and Nano Voltmeter Model 2182A/E; 7 ½ Digit, Digital Multimeter Model 2010/E; Electromagnet supplied by Polytronic corporation, 2015

TECHNICAL AND CHARACTERIZATION DETAILS

- Resistance and magnetoresistance measurements
- Temperature range : 15 to 380 K
- Temperature Stability:+/-0.1 K
- Resistivity range: micro to mega ohms
- Automated temperature control and resistance measurement
- Analog control of magnetic field
- Magnetic field sweep: +/- 0.5 T
- Magnetic field resolution: ~ +/-135 Oe
- Manual magnetic field control

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Resistance versus temperature at different applied currents for $La_{0.67}Ca_{0.33}MnO_3$ thin film. Appl. Phys. Lett. 103, 102408 (2013)

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resfac@cens.res.in

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MultiFerroic Tester

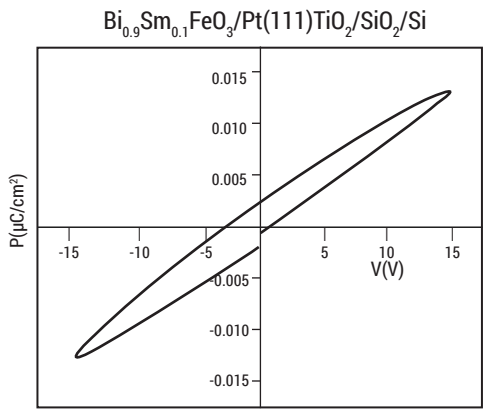
Radiant Technologies Inc., 2012

TECHNICAL AND CHARACTERIZATION DETAILS

Capable of executing a single pass hysteresis loop in 100µs with no interlacing of the data acquisition.

- Voltage Range (no external amp) ±200V
  Minimum Charge Resolution - 0.8fC
  Minimum Area Resolution - 0.08µm^2
  Maximum Charge Resolution - 5.26mC
  Maximum Area Resolution - 52.6cm^2
  Max Hysteresis Frequency - 250kHz
  Min Hysteresis Frequency - 0.03Hz
  Minimum Pulse Width - 0.05µs
  Minimum Pulse Rise Time (5V) - 400ns
  Max Pulse Width - 1s
  Max Delay between Pulses - 40ks
  Internal Clock - 25ns
  Minimum Leakage Current - 1pA
  Maximum Small Signal Cap Freq. - 1MHz
  Minimum Small Signal Cap Freq - 1Hz
  Output Rise Time Control - 105 scaling
  Input Capacitance ~60fF
- Hysteresis, pulse response, CV, and IV characteristics
- Fatigue, C(V), PUND, Imprint and Leakage Current measurements
- Link multiple tasks to create a custom program.
- Only room temperature measurement possible.
- We are fabricating a sample holder for low temperature measurement down to 10 K

REPRESENTATIVE ACQUIRED DATA & REFERENCE



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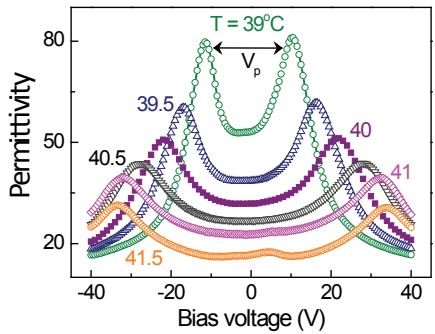
Gain/phase Analyzer

HP 4194A, 1995

TECHNICAL AND CHARACTERIZATION DETAILS

- High accuracy and wide range-Impedance measurement:
- Series and parallel circuit modes possible
- Frequency range: 100 Hz to 40 MHz,
- Capacitance range: 10fF-0.1F with an accuracy of 0.1 fF
- D range: 0.001-10 with accuracy of 0.0001
- G range: 10nS to 100nS with accuracy of 1nS

REPRESENTATIVE ACQUIRED DATA & REFERENCE



J. Phys.: Condens. Matter.,23, 105902, (2011).

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10

High Pressure Apparatus

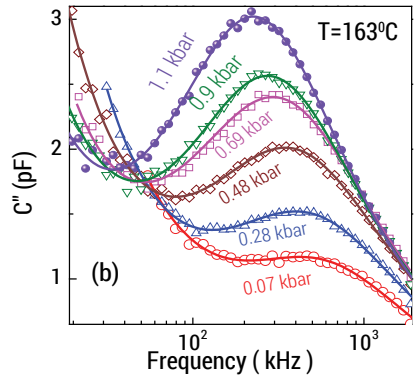
1995

TECHNICAL AND CHARACTERIZATION DETAILS

Apparatus fabricated in the laboratory

- Pressure range: 1 bar to 4000 bar, with an accuracy of 4 bar; Radial pressure;
- Temperature range: 30^{0}C to 200^{0}C with measuring accuracy of 0.1^{0}C
- Different measurements are possible: Laser transmission, Dielectric measurement, Polarisation, viscosity measurements

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Contact: shankar@cens.res.in
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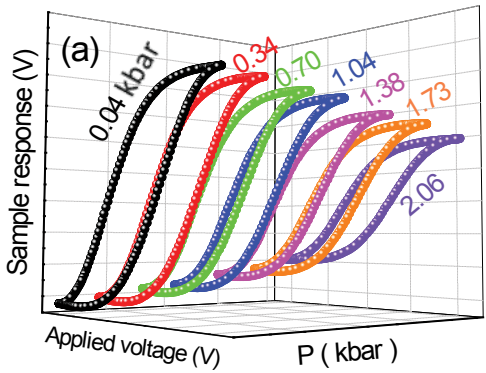


Phys. Rev. E, 87, 042504 (2013); J. Phys. Chem. B, 115, 10425 (2011).

11

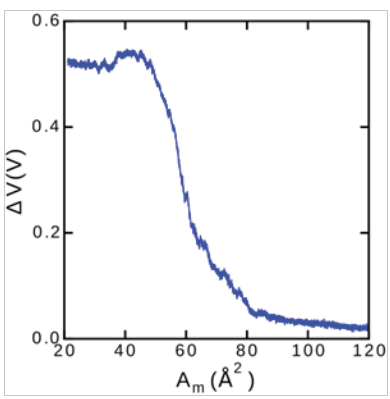
Electrostatic Voltmeter

Trek Model 320 C with probe 3250, 2014.

TECHNICAL AND CHARACTERIZATION DETAILS

- Measurement Range 0 to ±100 V DC or peak AC.
- Sensitivity 1 mV.
- Accuracy: Voltage Monitor Output Better than ±0.05% of full scale.
- Voltage Display Better than or equal to ±2 counts, referred to the voltage monitor
- Speed of Response (10% to 90%)
- Less than 300 ms for a 100 V step.
- Stability: Drift with Time Less than 50 ppm/hour, noncumulative.
- Drift with Temperature Less than 50 ppm/°C.
- (1:1 monitor output)
- Drift with Temperature Less than 100 ppm/°C
- Null Voltage Source: A calibrated 10 turn dial representing a 10 volt supply, with switch selectable polarity, used to produce zero volts output when the probe is coupled to a known zero volt surface.
- Also used to null contact potentials on dissimilar surfaces.
- Range: ±10 volts
- Accuracy: 1%
- Resolution: 20 mV
- Response Speed Control
- A front panel potentiometer that adjusts the speed/noise tradeoff of the Model 320C AC response.
- Drift/Spacing Null Adjustment: This back panel adjustment minimizes the variation in monitored voltage values as the probe to test surface spacing changes.
- Voltage Display, 31/2 digit LED display.
- Range Switch selectable for ±10 V or ±100 V full scale.
- Resolution: 10 V Range 0.01 V.
- 100 V Range: 0.1 V. Zero Offset ±1 count, referred to the voltage monitor.
- Sampling Rate 3 readings per second.

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Surface potential measurement of octyl cyanobiphenyl monolayer at the air-water interface

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Rheometer

TA Instruments ARG2, 2005

TECHNICAL AND CHARACTERIZATION DETAILS

- Advanced controlled stress, direct strain and controlled rate rheometer with a magnetic thrust bearing and a drag cup motor to allow nanotorque control.
- Torque range: 3 nNm to 200 mNm (oscillation) with 0.1 nNm resolution
- Angular Velocity Range: 0 to 300 rad/s
- Frequency Range: 7.5E-7 to 628 rad/s
- Normal Force: 0.005 to 50 N with 0.1 nNm resolution
- Cone-plate and plate-plate geometries
- Samples (melts to fluids) with viscosity range ~ 10mPaS to 10kPaS
- Temperature range -20 to 200^{0}C with +/- 0.1^{0}C resolution
- Typical sample thickness for a 20 mm plate-plate geometry is 2 mm.
- Shear viscosity measurements
- Linear and non-linear dynamic characterization
- Determination of yield stresses
- Dynamic testing after different pre-shear histories
- Step-strain measurements
- Monitoring the kinetics of curing
- The device is controlled by Rheology Advantage software.

REPRESENTATIVE ACQUIRED DATA & REFERENCE

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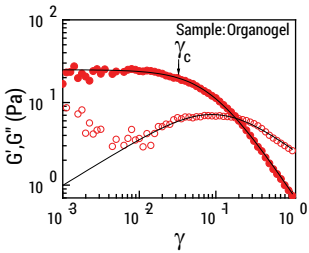
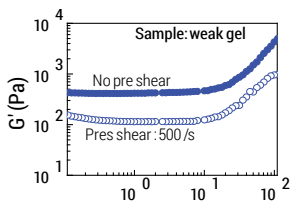
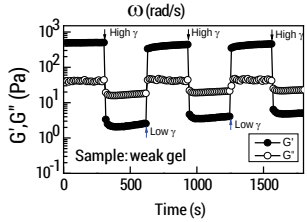


Soft glassy behaviour seen in a liquid crystal (LC) gel



Angular frequency dependence of a LC gel showing characteristics of a weak gel



Step-strain measurements of a LC gel indicating the robustness of the structure
J. Phys. Chem. B 114, 697 (2010).

13

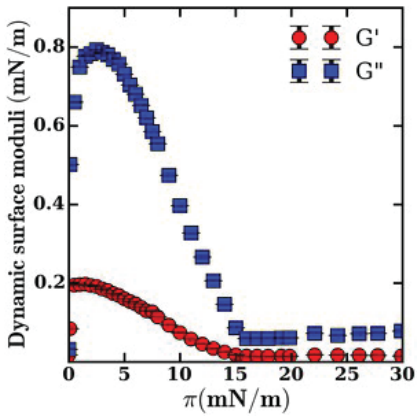
Interfacial Shear Rheometer

KSV NIMA, 2010

TECHNICAL AND CHARACTERIZATION DETAILS

- Dynamic moduli resolution: 0.001 mN/m,
- With KSV NIMA Langmuir Trough: 908 mm x 370 mm x 700 mm
- Surface Pressure sensor: sensitivity of 0.05 mN/m
- Frequency range: 0.06 to 25 rad/s (0.01 to 4 Hz)
- Strain range: $3x10^{-4}$ to 1.
- Probe: Magnetized sewing needle suspended in a channel.
- Detector: CCD camera.
- Software for instrument control and data collection.
- Dynamic shear moduli of the monolayer at interface as a factor of surface pressure, temperature, concentration, frequency and strain dependence can be studied.

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Dynamic shear moduli of eicosanol monolayer with surface pressure at the air-water interface.

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UV-Visible Spectrometer

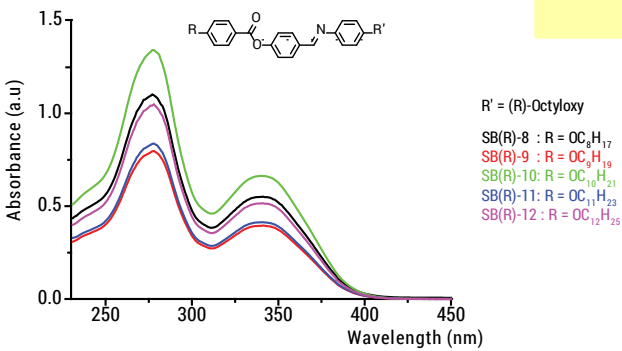
Perkin Elmer Lambda 20, 1996

TECHNICAL AND CHARACTERIZATION DETAILS

- Measures light absorption of samples (solutions & thin films) at different wavelengths in the range 190 - 1100 nm.
- It is a double beam spectrometer with microcomputer electronics, keyboard entry and fluorescence display.
- Monochromator: Holographic concave grating with 1053 lines/mm.
- Wavelength accuracy: + 0.3 ran at deuterium peak 656.1 nm.
- Spectral slit width: 2nm.
- Photochromic accuracy: ± 0.005 A at 1 A (measured with NBS 930 filters).
- Reproducibility: + 0.1 nm.
- Noise: < 0.0003 A (at 0 A, 500 nm, 2 sec response time).
- Stability: < 0.0003 A/h (at 500 nm, 1 sec response time, after warm up).
- Ordinate mode: Choice of %T, ABS or conc.
- Response time 0.1; 0 .2; 0 .5; 1 ; 2; 5; 10 sec
- Digital port: RS-232-C/V24 interface for connecting an Epson printer or an Epson PC; optional second RS-232-C/V24.
- Analog port for connecting an analog chart recorder

REPRESENTATIVE ACQUIRED DATA & REFERENCE

Contact: resfac@cens.res.in



UV-Vis spectrum obtained for the dilute solutions of the Schiff bases in CH_2Cl_2
New J. Chem., 39, 2011 (2015).

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UV-VIS-NIR Double Beam Spectrophotometer

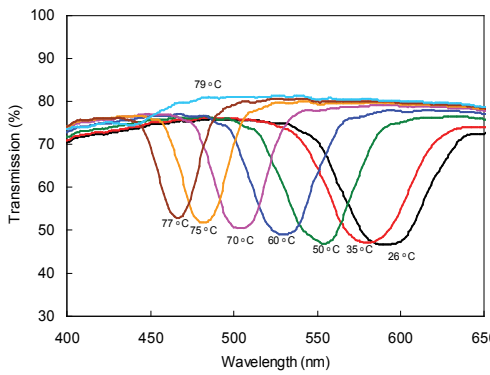
Shimadzu UV-3101PC, 2001

TECHNICAL AND CHARACTERIZATION DETAILS

- Films and liquids contained in cuvettes, as samples
- Wavelength: 190nm to 3200nm
- Spectral band width (slit width)
  9 steps in ultraviolet/visible region; 0.1, 0.2, 0.5, 0.8, 1, 2, 3, 5, 7.5nm
  12 steps in near-infrared region; 0.4, 0.6, 0.8, 1.2, 2, 3, 4, 6, 8, 12, 20, 30nm
- Resolution length range: 0.1nm
- Wavelength scanning speed:
  FAST 1600nm/min (with 2nm sampling interval)
  FAST 700nm/min
  MIDDLE 200nm/min These are the speeds when scanning with 0.5nm sampling interval.
  SLOW 100nm/min
  SUPER SLOW 50nm/min
- Switching of the light sources
  The light sources are switched automatically in conjunction with wavelength scanning. The wavelength at which the light sources are switched is selectable in the range of 282nm to 393nm in 0.1nm increments.
- Photometric range
  Absorbance: -4~5 Abs (up to 0.001 Abs.)
  Transmittance: 0~999.9%T (up to 0.01%)
  Reflectance: 0~999.9%R (up to 0.01%)

REPRESENTATIVE ACQUIRED DATA & REFERENCE

Selective reflection from a cholesteric film



Contact: resfac@cens.res.in

16

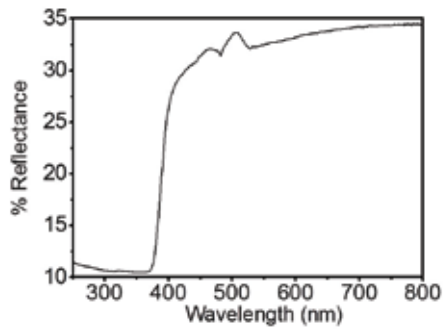
UV-Visible-NIR Spectrophotometer with Diffuse Reflectance

Perkin–Elmer Lambda 750, 2015

TECHNICAL AND CHARACTERIZATION DETAILS

- High performance UV/Vis/NIR double beam, double monochromator, ratio recording spectrometer.
- Wavelength range 190-3300 nm
- Absorbance, transmission of fluids, thin films and diffuse reflectance of thin films, powders
- Integrating 100 mm Spectralon coated sphere, which can be used without any adjustment- reflectance wavelength range 200-2500 nm
- Thin film solid sample holder for thin film transmission measurement
- Tungsten-halogen and deuterium lamp with automatic source change
- Photomultiplier R955 detector for UV/Visible range and peltier cooled PbS detector for NIR wavelength range
- Spectral bandwidth from 0.17 -5 nm UV/Vis and 0.2 – 20 nm NIR
- Beam splitting system- chopper (46+ Hz, cycle: dark/sample/dark/reference, chopper segment signal correction CSSC)
- Photometric range- 6 A
- UV/Vis resolution ≤ 0.17 nm ,NIR resolution ≤ 0.20 nm
- System control via the UV-WinLab operating software for compatible Personal Computers

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Diffuse reflectance spectra from ZnO nanoparticles

Contact: resfac@cens.res.in

17

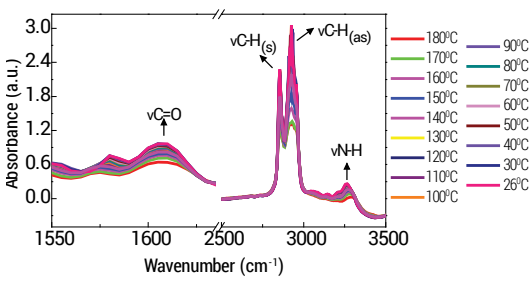
FT – IR Spectrometer

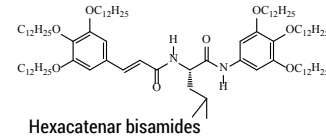
Perkin Elmer Spectrum 1000, 1996

TECHNICAL AND CHARACTERIZATION DETAILS

- It gives a spectrum (fingerprint profile) of a sample with absorption peaks corresponding to the frequencies of vibrations between the atomic-bonds
- The spectra of solid samples either in KBr or Nujol mull and liquids (neat) can be recorded
- Signal-to-noise performance makes it the highest performing, research grade FT-IR system and provides the highest levels of sensitivity.
- Number of background and sample scan can be set.
- Source: MIR
- Beam split : KBr
- Detector: DTGS (Deuterated triglycine sulphate detector)
- Interferogram: Bi-directional
- J stop size: Size in nm
- Resolution:1.00 cm^{-1}
- IR laser wavenumber: Wavenumber in cm^{-1}.
- Electronically stabilized source and detector for repeatable measurements.
- Scan parameter such as resolution and range can be set.
- Can be used with Mettler Hot stage
- Instrument LCD's display with go button increase productivity and deliver ease-of-use H_2O/CO_2 removal, enhances accuracy and reproducibility of data.
- Spectrum software provides intuitive user operation and helps ensure consistent results, day-to-day, user-to-user.

REPRESENTATIVE ACQUIRED DATA & REFERENCE





The regions of the FTIR spectra recorded at different temperature intervals during cooling the hexacatenar bisamides from the isotropic phase.
Tetrahedron, 68, 6528 (2012).

Contact: resfac@cens.res.in

18

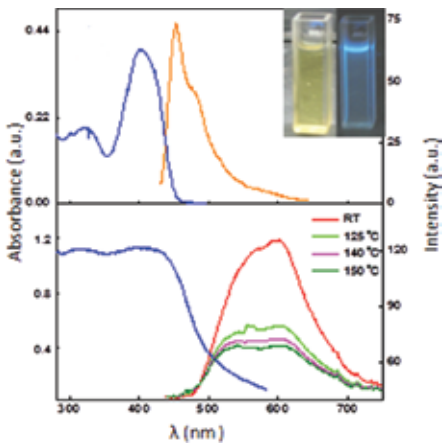
Spectrofluorometer

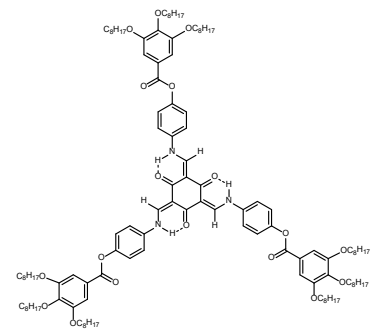
Horiba Jobin Yvon Fluorolog-3, 2008

TECHNICAL AND CHARACTERIZATION DETAILS

- It provides fluorescence, typically occurring within about ~ 10^{-9} s, (as either an excitation or emission spectrum) as well as reflectance measurement spectra
- Measures the intensity and the wavelength distribution of the light emitted as fluorescence from a molecule excited at a specific wavelength or wavelengths within the absorption band of a particular fluorophore
- Fluorescence of solid samples, solutions, thin film, liquid crystal thin films (as a function of temperature) can be obtained.
- Possesses a double –grating monochromator at the excitation position and a single –grating emission monochromator in an L configuration.
- It features 450 W ozone free Xe source and power supply double Czerny Turner emission spectrometer with 1200g/mm grating blazed at 500 nm, continuously adjustable entrance, exit , and intermediate slits operated under computer
- Samples can be analyzed at very low concentrations (sub-picomolar); photon-counting detection strips noise away from weak signals.
- It monitors the excitation beam with a wavelength-independent reference detector to correct variations in the intensity of the excitation source.

REPRESENTATIVE ACQUIRED DATA & REFERENCE





Absorption and emission spectra in THF solution (top panels) and in the thin films of the Col phase (lower panels) obtained for star-shaped LC (left); Inset shows the pictures of solutions as seen without (LHS) and with the illumination (RHS) of 365 nm light. Note that for thin films of Col phase, the spectra were recorded as a function of temperature (see RHS traces of lower panels).
J. Org. Chem, 78, 527 (2013)

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19 Circular Dichroism Spectropolarimeter

Jasco J-810, 2001

TECHNICAL AND CHARACTERIZATION DETAILS

- Determines the optical purity of chiral molecules
- Measures the left-and right-handed circularly polarized light of optically active molecules.
- Measures the chiroptical properties of solutions (chiral solutes, viz., peptides and proteins, dissolved in solvent)
- Determines the chiroptical behaviour of chiral liquid crystal samples (as a function of temperature)
- Determines the binding constants
- Useful in determining kinetics of folding and unfolding of macromolecules
- Provides thermodynamic parameters from temperature dependencies of CD signals
- Equipped with Mettler FP90 hot stage
- Comprises a variable wavelength polarimeter and absorption spectrophotometer (163-900 nm)
- Up to four channels can be acquired simultaneously; the internal signals are selected from CD, FDCD, ORD, LD UV and Fluorescence
- The acquired data are controlled by Jasco's spectra manager
- Light source: 150 W air cooled Xe lamp or 450 W water cooled Xe lamp (option)
- Detector: Head-on photomultiplier tube
- Modulator: Piezoelastic modulator
- Spectral bandwidth: 0.01 to 15 nm; slit width: 1 to 3000 µm
- Response: 0.5 msec to 32 sec
- Scanning system: Continuous scan& step scan
- Scanning speeds: 1 to 10000 nm/min (continuous scan)
- Data interval: 0.025 to 10 nm (continuous scan); 0.1 to 100 nm (step scan); 0.5 msec to 60 min (time change)
- CD full scale: ±10, 200, 2000 mdeg

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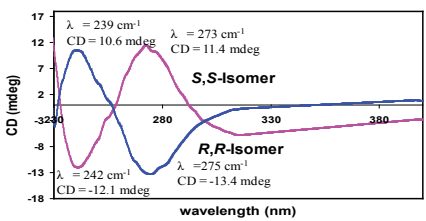
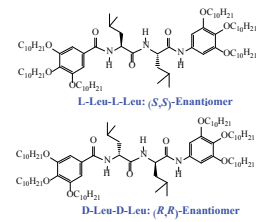
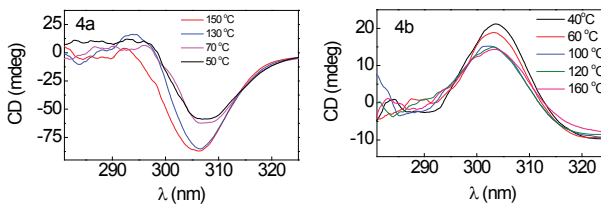
REPRESENTATIVE ACQUIRED DATA & REFERENCE





CD spectra of the dipeptides S,S- & R,R-isomers in CH_2Cl_2



CD spectra of Col phase as a function of temperature of S, S-(a) & R, R-isomer (b). Chem. Eur. J., 14, 10462 (2008).

20

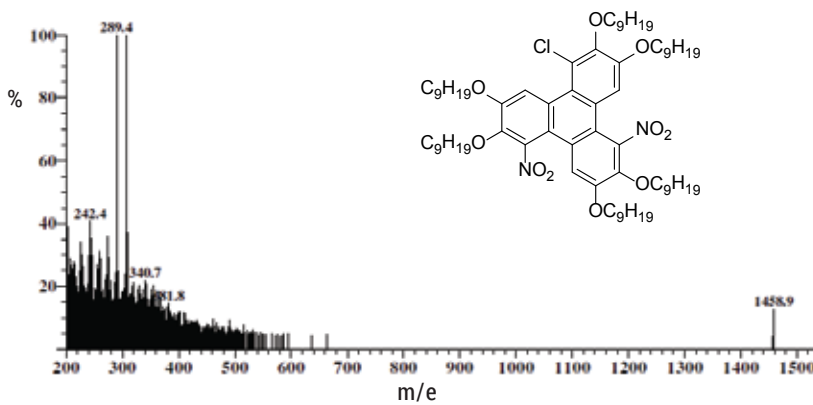
Mass Spectrometer

JEOL JMS 600H, 1998

TECHNICAL AND CHARACTERIZATION DETAILS

- It is a compact double-focusing, high-resolution, magnetic sector mass equipment
- Measures the accurate mass of a variety of organic samples viz., liquid, solid samples in solution and neat form (volatile sample) etc.
- It can be used for both qualitative and quantitative analysis by which the structure of unknown compounds can be tentatively determined.
- Samples with molecular weight up to 700 amu, may be introduced into the ion source using a direct insertion probe and ionized by electron ionization (EI) and/or chemical ionization (CI).
  EI- works at a impact of 70 eV electrons, designed to produce gaseous ions for analysis
  CI - involves proton transfer of H^+ from CH_5^+ and is a form of gas-phase chemistry and thus, it is softer, less energetic, than EI mode.
- Polar and nonvolatile samples with molecular weight up to 1700 amu, are usually introduced into the ion source by the FAB probe and ionized by fast atom bombardment (FAB). FAB mode - works on beam of Argon atoms
- MS route ver.1.8.00 software is used to tune and calibrate, data acquisition and data reduction
- Magnetic analyzer is used to trap the ions under vacuum (10^{-5} to 10^{-8} Torr) atmosphere.

REPRESENTATIVE ACQUIRED DATA & REFERENCE



MS data of structural Isomer. Liq. Cryst., 40, 1477 (2013).

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skv@cens.res.in

21

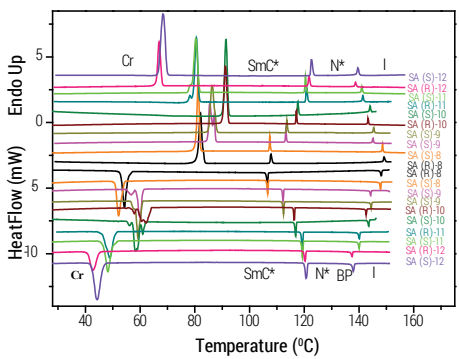
Differential Scanning Calorimeter

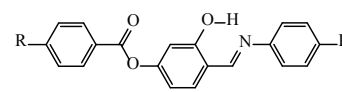
Perkin Elmer Diamond -Series, 2008

TECHNICAL AND CHARACTERIZATION DETAILS

- Measures melting temperature, heat of fusion, latent heat of melting, glass transition temperature, crystalline phase transition temperature and energy, precipitation energy and temperature
- Determines the amount of energy absorbed or released by a sample when it is heated or cooled, providing quantitative and qualitative data on endothermic and exothermic processes.
- Measurements are highly quantitative.
- Works on power compensation temperature null principle.
- Comprise independent dual furnaces constructed of Platinum-Iridium alloys with independent platinum resistance.
- Comprises distributed, platinum resistance thermometers.
- Auto sampler: up to 44 samples can be measured, in series unattended.
- It has ability to be customized through pyris player to meet analysis needs.
- Range: -170°C to 730°C
- Accuracy / Precision ± 0.1°C/ ±0 .01°C.
- Temperature overshoot: 100°C / min.
- Scanning rates: Heating /cooling 0.01°C to 500°C / min.
- High pressure cell: Extends the capability of the power compensation designed to elevated pressure measurements.
- Straight forward, pure linear heating ramps and isothermal scans.
- Provides clearer information about glass transition event.
- Atmosphere: Static, dynamic including nitrogen, argon, helium carbon dioxide, air, oxygen over full temperature range.

REPRESENTATIVE ACQUIRED DATA & REFERENCE





R' = (S)-Octyloxy	R' = (R)-Octyloxy
SA (S)-8: R=OC_8H_{17} (96%)	SA (R)-8: R=OC_8H_{17} (93%)
SA (S)-9: R=OC_9H_{19} (91%)	SA (R)-9: R=OC_9H_{19} (92%)
SA (S)-10: R=$OC_{10}H_{21}$ (93%)	SA (R)-10: R=$OC_{10}H_{21}$ (94%)
SA (S)-11: R=$OC_{11}H_{23}$ (91%)	SA (R)-11: R=$OC_{11}H_{23}$ (90%)
SA (S)-12: R=$OC_{12}H_{25}$ (90%)	SA (R)-12: R=$OC_{12}H_{25}$ (91%)

Contact: resfac@cens.res.in

DSC thermograms recorded during the first heating-cooling cycles at a rate of 5°C for the ten mesogens. (five pairs of enantiomers)
J. Phys. Chem. B 119, 4539 (2015)

22

CHNS/O Elemental Analyser

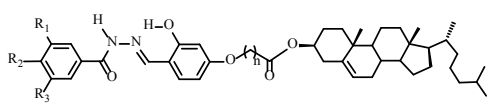
Perkin Elmer 2400, 2015

TECHNICAL AND CHARACTERIZATION DETAILS

- Determines weight percent carbon, hydrogen, nitrogen, sulfur or oxygen of a variety of samples
- Built with EA Data Manager software
- Adopts frontal chromatography for simple reliable and accurate measurements
- Multiple modes of operation: CHN or CHNS Mode or Oxygen Mode.
- Readily/conveniently switches between Oxygen and CHN/CHNS modes
- Analysis Times: CHN - 6 mins ; CHNS - 8 mins; Oxygen- 4 mins
- Analytical range: C 0.001-3.6 mg; H 0.001-1.0 mg; N 0.001-6.0 mg; S 0.001-2.0 mg; O 0.001-2.0 mg
- Sample required for analysis : 1-3 mg
- Detector TCD (thermal conductivity detector).
- Carrier Gas: Helium or Argon.
- Combustion gas: Oxygen.
- Adopts a mixture of two combustion techniques to ensure complete sample combustion.
- Pneumatic Gas Air, Nitrogen or Argon.
- Up to 60 samples can be position at a time (60 samples can analyzed in series, unattended)
- The weight of the samples is automatically fed to the system.
- Provides permanent record of instrument timing, leak testing and condition monitoring.
- Laboratory environment: Temperature range 12 to 32 ºC; Humidity 20 - 80% non-condensing
- Allows for customizable combustion conditions to ensure complete combustion while minimizing oxygen use.
- Accuracy: ≤ 0.3% - In Helium carrier gas and certified reference materials
- Precision: ≤ 0.2% - In Helium carrier gas using certified reference materials

REPRESENTATIVE ACQUIRED DATA & REFERENCE

Contact: resfac@cens.res.in



1: n = 4; $R_1 = R_3 = H$; $R_2 = OC_{10}H_{21}$; 2: n = 4; $R_1 = H$; $R_2 = R_3 = OC_{10}H_{21}$

3: n =3; $R_1 = R_2 = R_3 = OC_{10}H_{21}$

Samples	C	H	N	Remark
	Theoretical	Theoretical	Theoretical	
	Found	Found	Found	
	Difference	Difference	Difference	
	76.32	9.61	3.18	
1	76.70	9.51	3.44	Acceptable
	-0.38	+0.1	-0.26	
	76.40	10.10	2.70	
2	76.61	10.06	3.01	Acceptable
	-0.21	+0.04	-0.31	
	76.35	10.42	2.37	
3	46.00	10.40	2.63	Acceptable
	+0.35	+0.02	-0.26	

23

Single Wavelength Null Imaging Ellipsometry

Accurion GmbH EP3, 2010

TECHNICAL AND CHARACTERIZATION DETAILS

- Null imaging ellipsometer equipped with polarizer, analyzer, compensator, objective and CCD detector.
- Single Wavelength: 532 nm, 15 mW laser source
- Motorized Goniometer.
- Angleofincidence range: 40 – 90 degree
- Angle resolution: 0.001 degree
- Absolute angle accuracy: 0.01 degree
- Speed of motion: variable, approx. 10 degree/second
- XY sample stage: Manual
- Spatial resolution (down to 2 µm).
- 10X Objective (Nikon)
- Ellipsometric precision: Delta/Psi 0.002 deg
- Absolute accuracy 0.1 deg
- Simultaneous measurement on multiple ROI.
- EP3 View software for instrument control and data collection under Windows operating system.
- Adaptation for a mini Langmuir Trough: 370mm x 75mm x 10mm
- Active vibration isolation.
- Can also serve as Brewster angle microscope (BAM) for visualizing textures and phases.

REPRESENTATIVE ACQUIRED DATA & REFERENCE

Imaging Ellipsometric study of the smectic domains.
Phys. Chem. Chem. Phys. 16, 1276 (2014)

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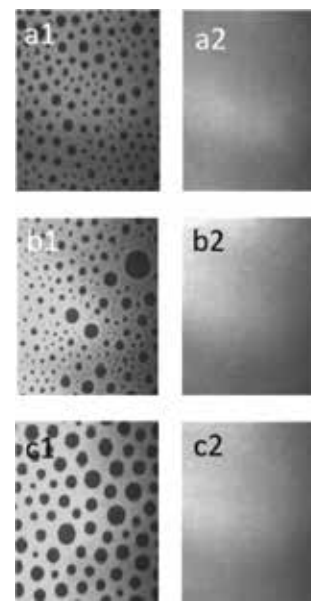


BAM images for nCB at different monolayer phases at air/water interface.
J. Appl. Phys. 117, 245311 (2015)

24

Research Grade Polarizing microscope

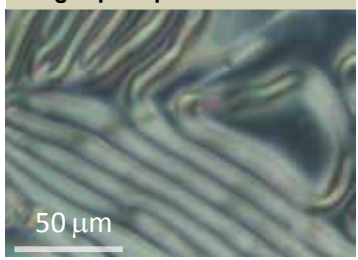
Leica DM4500 P, 2008

TECHNICAL AND CHARACTERIZATION DETAILS

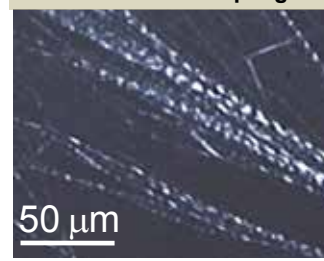
- Polarizing examinations of wide variety of materials such as liquid crystals, minerals, polymers, gels etc.
- Objectives: 5X, 10X, 20X, 50X
- Automatic diaphragm setting and light intensity
- Constant color intensity control for constant color temperature
- Condenser cap swings in and out automatically
- Transmitted light mode: Polarization contrast, Orthoscopy, Conoscopy , Brightfield, Phase contrast and Darkfield
- Incident light mode: Polarization contrast and Brightfield
- Fully integrated conoscopy beam path
- Sample thickness ~ a few to tens of microns
- CCD (Leica make) camera with Leica Application Suite software to capture and analyse the microscopic images.

REPRESENTATIVE ACQUIRED DATA & REFERENCE

Finger-print pattern in N-sol



Gel fibers in isotropic gel



Polarizing microscopic images acquired using DM4500 P in the transmitted light mode
Soft Matter 7, 10151-10161 (2011); ChemPhysChem 14, 331-337 (2013).

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resfac@cens.res.in

25

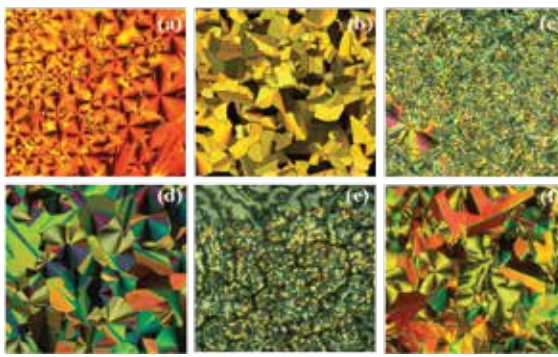
Polarizing Microscope

Olympus Bx51-75e21p, 2007

TECHNICAL AND CHARACTERIZATION DETAILS

- Source: halogen lamps (30 W and 100 W)
- M Plan Semi apochromat objective, 5X/0.15 W D 20.0mm
- Long working distance M Plan semi apochromat objective 10X/0.25 W D 21.0
- Long working distance M Plan semi apochromat objective 20X/0.40 W D 12.0
- Long working distance M Plan semi apochromat objective 50X/0.80 W D 10.6
- Quadruple, revolving nosepiece,
- Circular rotatable stage, graduated, including stage insert plate
- Interference green contrast filter
- Polarising condenser, N A 0.9-0.18
- 1/4 wavelength retardation plate 1 No
- Polarising intermediate attachment for Conoscopic and Orthoscopic observation including orientation plate
- Reflected light bright field illumination tube
- With Mettler Hot stage.

REPRESENTATIVE ACQUIRED DATA & REFERENCE



POM textures of bent-core liquid crystal molecules obtained on cooling from the isotropic liquid: (a) B1 mesophase at 116°C (b) B1 mesophase at 110°C (c) B2 mesophase at 108°C (d) B1 mesophase at 140°C (e) B2 mesophase at 130°C and (f) B1 mesophase at 155°C

Liq. Cryst., 40, 1238 (2013)

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26

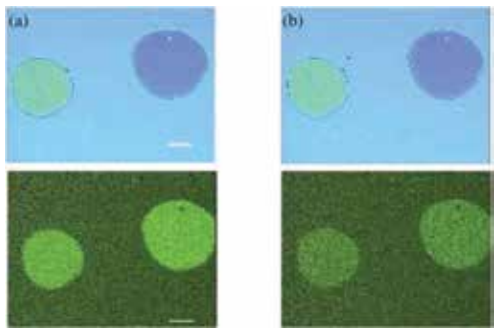
Optical Fluorescence, Reflection Microscope

Olympus BX51, 2013

TECHNICAL AND CHARACTERIZATION DETAILS

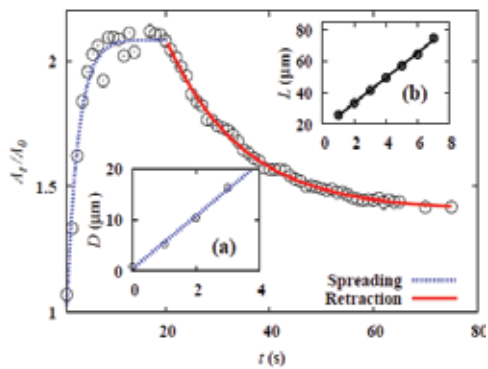
- Optical microscope
- Reflection: Bright field, dark field, DIC
- Reflected fluorescence observation
- Transmission and polarization
- Filters: Built-in ND6, ND25, LBD and few optional filters
- Objectives: LMPLFLN series: 5X, 10X, 20X and 50X
  UPLFLN series: 20X and 40X
  UPLSAP series: 04X
- Source: 1. 100 W mercury lamp
  2. 75 W Xenon lamp
  3. 100 W Halogen lamp
- Detector: CCD Camera (Model DP73 interfaced with microscope)

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Dye doped smectic domain transferred onto a ITO coated glass substrate.

Liquid Crystals, 2014, 41, No. 320 (2014)



Normalized area of the dye doped smectic domain with time, deduced from images.

Soft Matter 8, 11180 (2012)

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27

Research Grade Polarizing Microscope with Confocal Capability and Digital Imaging System

Carl Zeiss Axio imager M1m 2008

TECHNICAL AND CHARACTERIZATION DETAILS

- Motorized polarizing microscope for incident and transmitted light studies
- Z-drive: stepsize 25 nm.
- Objectives (working distance in parentheses):
  Plan-Apochromat 63X/1.40 Oil (0.19 mm);
  LD Epiplan-Neofluar 50X/0.55 (9 mm);
  Epiplan-Neofluar 50X/0.8 (0.58 mm);
  Epiplan-Neofluar 20X/0.5 (2.1 mm);
  LD Epiplan-Neofluar 20X/0.22 (12.1 mm);
  LD Epiplan 20X/0.4 (7.2 mm);
  Epiplan 10X/0.2 (18.4 mm);
  Epiplan-Neofluar 10X/0.25 (9.3 mm);
  Epiplan-Neofluar 5X/0.13 (15.8 mm).
- Compensators: Tilting K 0-30λ; tilting 0-5λ; Wedge 0-4λ; λ and λ/4 plates
- High-resolution digital imaging: AxioCam MRc5 Camera; software for time-lapse imaging.
- Sources: Halogen lamp 12 V/100 W Adjustment of light source continuous, approx. 3 to 12 V
- Mercury vapor lamp HBO 100 W; HBO 50 W with fibre-optic coupling
- LSM 5 Laser Scanning Microscope Exciter with:
  Sources: Multiline Ar laser 458/488/514 (25 mW), He-Ne laser (1 mW)
  Detector: single channel PMT detector in reflection; Transmitted light photodetector.
- Microscope Hot-Stage: INSTEC HCS402 (Ambient–400^{0}C) with STC 200 Temperature Controller **http://www.instec.com/pdf/brochures/C31-1-HCS402.pdf**
- Accessories for electric-field effects:
  Function Generator: Stanford Research Systems SRS Model DS 345 30MHz
  Voltage Amplifier: FLC Electronics A800 (x100)
  Multimeter: Model Keithleyl 2002
  Photosensor Amplifier: Model Hamamatsu Type C9329 with Si detectors.
  http://www.hamamatsu.com/jp/en/C9329.html
  PC Oscilloscope PICO 4262

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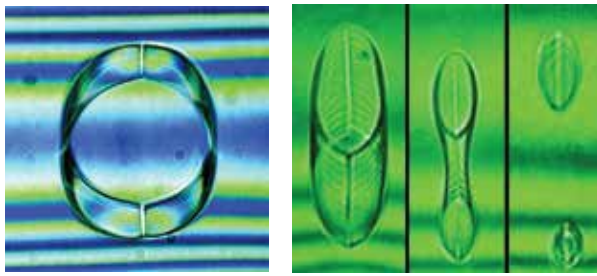
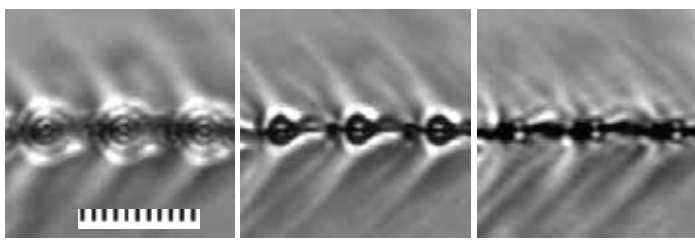
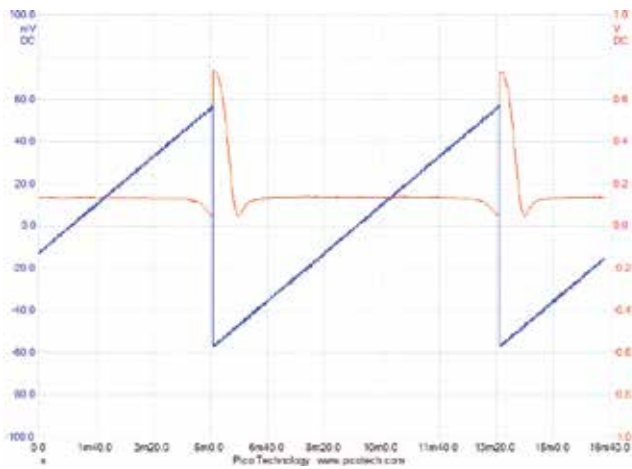
REPRESENTATIVE ACQUIRED DATA & REFERENCE



(Left) Electric-field-induced cylindrical loop-wall in a suspended nematic film captured in birefringence contrast. (Right) Continued division of the loop-wall under high electrical stress; J. Phys. Chem. B, 112,13509 (2008).



Z-stacked LSM images of grain boundary between oppositely twisted regions of a smectic C liquid crystal, showing focal conic domains.



Picoscope recording of optical response of a nematic sample to an applied saw-tooth wave.

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Field Emission Scanning Electron Microscopy (FESEM)

TESCAN-MIRA 3 LMH, 2014 and

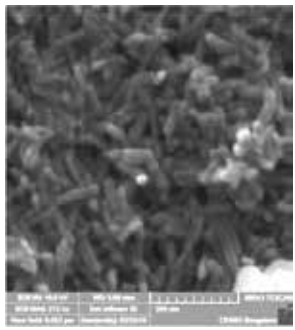
Energy Dispersive X-ray Spectrometer (EDS)

QUANTAX 200 with XFlash BRUKER, 2014

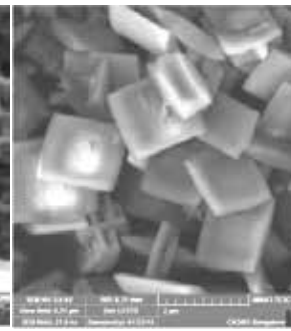
TECHNICAL AND CHARACTERIZATION DETAILS

- 2X to10,00,000X Magnification
- High vacuum and low vacuum (up to 500 Pa) imaging
- IR camera for chamber view
- Everhart-Thornley type detectors with YAG scintillators
- Chamber SE detector, Resolution-1.2 nm at 30 kV (SE: Secondary electrons)
- In-Beam SE detector,Resolution-1.0 nm at 30 kV
- In-Beam backscattered SE detector , Resolution-2.0 nm at 15 kV
- Low vacuum SE detector with differentially pumped detection chamber and a dedicated turbo molecular pump , Resolution-3.0 nm at 30 kV
- Beam deceleration mode (BDM) with in-Beam annular SE detector for thin films, semiconductors and also for specimens prone to radiation damages, Resolution - 1.8nm at 1kV
- Air cooled column
- Pneumatic anti-vibration suspension system
- Accelerating voltage- 50 V to 30 kV in steps of 10 V
- Probe current 2 pA to 200 nA
- Probe current detector
- Field of view- 6.4 mm at WD 10 mm and 20 mm at WD 30 mm
- 20 ns to 10 ms per pixel scanning speed (Adjustable continuously)
- Selectable image frame size up to 8192 X 8192 pixels
- Point & line scan, image rotation & shift and tilt compensation
- Sample stage movements : Motorized X,Y,Z = 80 mm, 60 mm, 47 mm respectively
  Rotation = 360 deg - motorized
  Tilt = -80^0 to $+80^0$ - motorized
- Compucentric stage
- Multiple specimen holder
- Fixed Scanning transmission electron microscope (STEM) Detector
- Sample prepared using standard TEM grids for sample insertion
- Resolution in high vacuum- 0.8 nm at 30 kV
- Bright field and dark field imaging
- Energy Dispersive X-ray Spectrometer (EDXS) having
- Peltier cooled Silicon drift detector (SDD)
- Detection from Boron (5) to Americium (95)
- Maximum input count Rate > 1000 kcps
- 30 mm^2 Active Area
- Resolution <129 eV (MnKalpha)
- QUANTAX-Signal processing unit SVE 6, for high output count rates
- ESPRIT Quant-automatic software tools for standardless quantitative spectra analysis
- Image acquisition from SE, BSE sources (selectable)
- Multi point, line scan and mapping (ultra fast digital elemental mapping with unlimited number of elements), histograms, binary and ternary charts

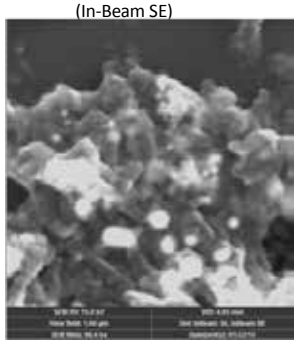
REPRESENTATIVE ACQUIRED DATA & REFERENCE

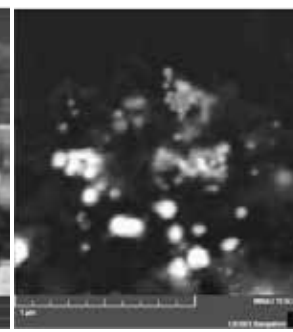


ZnO Nanorods
(In-Beam SE)

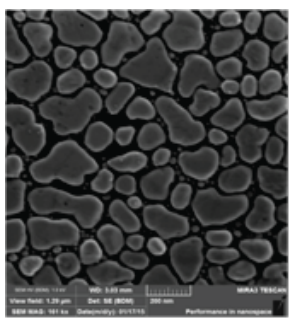


Zeolite (Low vacuum mode)

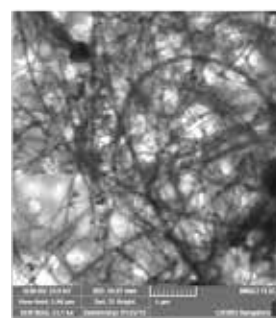




Au on carbon (In-Beam SE & BSE image)

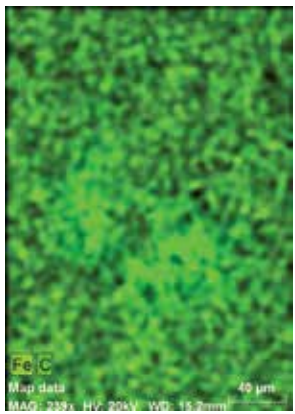


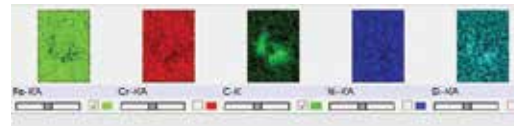
Au on Si- SE-BDM image at 1 kV



STEM Image of Carbon Nanotubes (CNTs) (TE Bright field)

REPRESENTATIVE ACQUIRED DATA & REFERENCE





EDS elemental mapping & spectra of Cr-Ni steel as a standard sample

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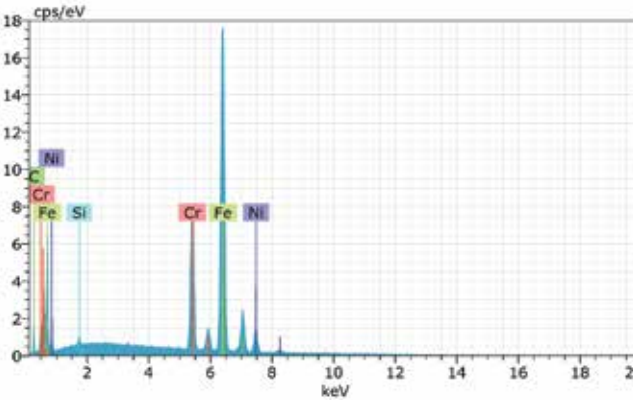

Quantification of EDAX spectra of Cr-Ni steel

Element	Series [wt.%]	unn. C [wt.%]	norm. C [at.%]	Atom. C [wt.%]	Error (3 Sigma)
Iron	K-series	67.70	67.30	51.29	5.50
Chromium	K-series	16.71	16.61	13.60	1.45
Carbon	K-series	8.28	8.23	29.16	4.42
Nickel	K-series	7.57	7.52	5.46	0.75
Silicon	K-series	0.33	0.33	0.50	0.13
	Total:	100.59	100.00	100.00	

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Atomic Force Microscope

Agilent Technologies 5500, 2010

TECHNICAL AND CHARACTERIZATION DETAILS

Imaging Modes:

- Contact Mode AFM & F-Z spectroscopy for topography imaging and force measurements
- Intermittent Contact Mode AFM & F-Z spectroscopy
- Scanning Tunneling Microscopy & Spectroscopy
- Kelvin Probe Microscopy for mapping surface potential
- Magnetic Force Microscopy for mapping magnetic domains
- Electric Force Microscopy for mapping electric field gradient
- Current Sensing Atomic Force Microscopy & I-V spectroscopy for current images
- Piezoresponse force microscopy and spectroscopy
- Nanolithography for patterning nanometer-scale structures

Sample types: Thin films, polished solids, dispersed powders on substrates like silicon, HOPG, Au/mica, quartz

- Sample dimensions: X,Y (max) 20mm, 35mm for ambient AFM imaging, XY (max) 20mm for liquid cell AFM imaging

Top down multipurpose closed loop large scanner (XY 90µm, Z 8µm), resolution for small area scans <500nm x 500nm, with interchangeable nose-cones for STM, AFM, CSAFM, AC-AFM

- Top down multipurpose open small scanner (XY 9µm, Z 2µm), provides atomic resolution, with interchangeable nose-cones for STM, AFM, CSAFM, AC-AFM.
- Scanners compatible with environmental and temperature control options
- STM scanner (XY 10 µm, Z 1.6 µm)
- AFM head with easy laser alignment and high resolution CCD camera
- Vibration and acoustic isolation chamber
- Heating sample stage (up to 250°C)
- Liquid cell imaging
- Environmental control chamber
- PicoView software capable of real-time 3D data rendering
- PicoImage software for analysis and post-processing images
- PicoLith software for nanolithography

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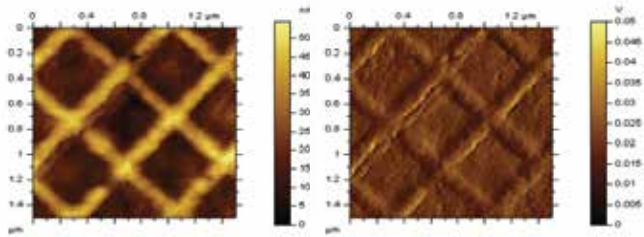
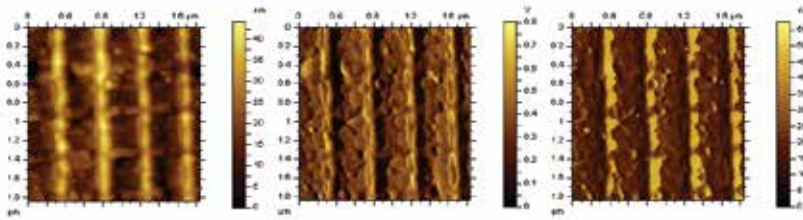
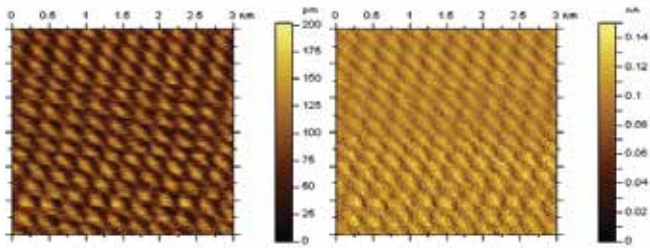
REPRESENTATIVE ACQUIRED DATA & REFERENCE



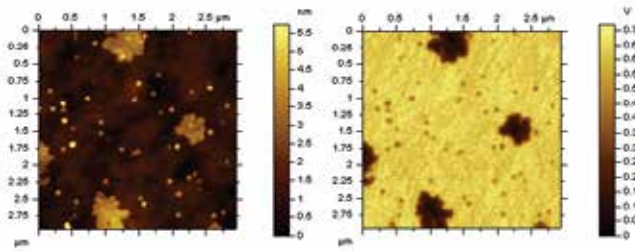
Contact mode AFM: Pt Grating on a silicon grid (Topography & Deflection channels).



Intermittent contact mode AFM: Cellulose acetate (Topography, Amplitude and Phase channels)

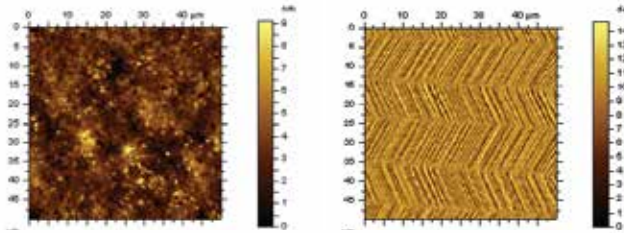


Scanning Tunneling Microscopy: HOPG substrate (Topography & Current channels)

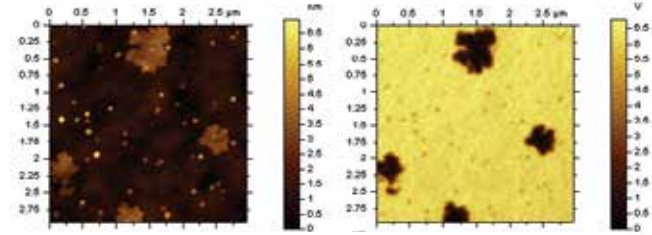


Kelvin Probe Microscopy: Perfluoroalkyl-alkane Topography and Surface Potential channels

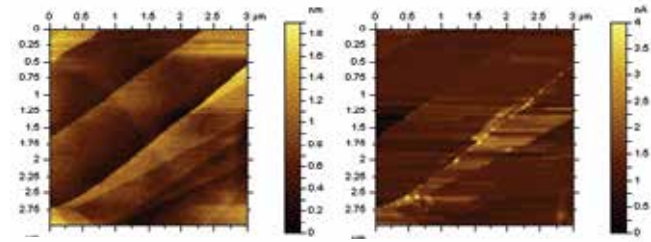
REPRESENTATIVE ACQUIRED DATA & REFERENCE



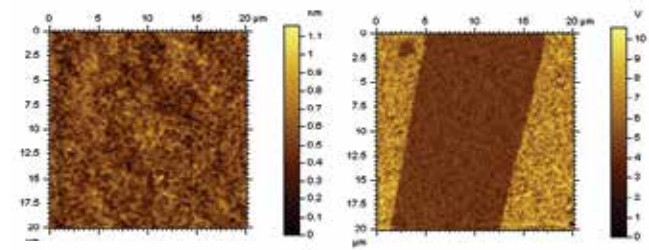
Magnetic Force Microscopy: Video tape (Topography and Phase channels)



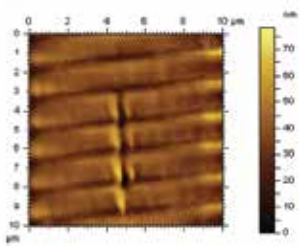
Electric Force Microscopy: Perfluoroalkyl-alkane (Topography and Phase channels)



Current Sensing AFM: HOPG substrate (Topography and Current channels)



Piezoresponse Force Microscopy: Electric field patterned Lithium Niobate (Topography and piezoresponse)



Nanolithography: scratching on compact disc

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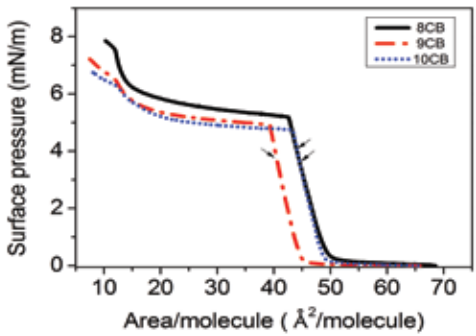
Langmuir - Blodgett Trough

KSV - NIMA 2000, 2009

TECHNICAL AND CHARACTERIZATION DETAILS

- Compression/relaxation isotherms
- Dilational rheology
- Analysis of monolayer kinetics
- Dipping: Langmuir-Blodgett film deposition
- Dimension: 580 mm x 150 mm x 10mm
- Surface pressure sensor: sensitivity 0.05mN/m

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Surface pressure-area per molecule isotherms recorded for n-alkyl cyan biphenyl materials .
J. App. Phy.,117, 245311 (2015).

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resfac@cens.res.in

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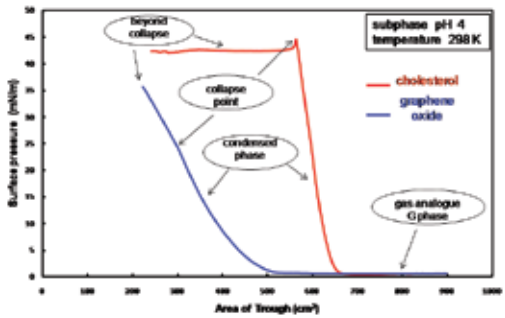
Alternate Layer Langmuir - Blodgett Trough

KSV - NIMA 5000, 2011

TECHNICAL AND CHARACTERIZATION DETAILS

- Compression/relaxation isotherms
- Dilational rheology
- Analysis of monolayer kinetics
- Dipping: Langmuir-Blodgett film deposition
- Surface Pressure Sensor: Sensitivity - 0.05 mN/m
- Alternate Langmuir-Blodgett film deposition
- Has two compartments with a movable arm : Combination of two troughs so as to facilitate deposition of two monolayers simultaneously.
- Dimension of each compartment: 775 mm x 120 mm
- Total subphase volume : 6L

REPRESENTATIVE ACQUIRED DATA & REFERENCE



Surface pressure – area per molecule isotherms for graphene oxide and cholesterol at air-water interface.

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Thermal Vacuum Evaporator

Vacuum Techniques, 2014

TECHNICAL AND CHARACTERIZATION DETAILS

- Vacuum coating unit for thin film depositions
- Belljar – chamber diameter = 30 cm & height = 50 cm, compatible to 10^{-6} mbar
- Adjustable source - substrate height
- Resistive heating of the source material
- Radiant heater for substrate heating (up to 300°C)
- Substrate rotation
- Rotary pump speed 250 L/min
- Diffusion pump speed 280 L/sec (facility with LN2 trap)
- HT Power supply for ion cleaning (3.5KV, 5mA)
- LT power supply (10V, 200A and 20V, 100A)
- Thickness monitor based on quartz crystal
- Mo and W boats, W filaments
- Four exchangeable feedthroughs

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RF/DC Sputtering System

VR Technologies, 2013

TECHNICAL AND CHARACTERIZATION DETAILS

- Two magnetron sputtering electrodes (Sputtering down configuration)
- Diffusion vacuum pumping system
- RF Power supply (Model: R601, SEREN IPS Inc, USA) - 600 W, 13.56 MHz
- DC supply: 50-1000 V
- Substrate heater upto 900°C
- Substrate rotation for uniform deposition
- Mass flow controllers (AALBORG, USA); - Two nos. (Ar&O_2)
- Source shutter
- Deposition of oxide films, such as, ZnO, Manganites, Multiferroics,
- Deposition of metal films, such as, Au, Cu, Al, Fe, Ni, Mn, Co,
- Shadow masking possible
- In situ deposition of bilayers/multilayers possible

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CeNS

नैनो एवं मृदु पदार्थ विज्ञान केंद्र

CENTRE FOR NANO AND SOFT MATTER SCIENCES

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Email: admin@cnsms.res.in Website: www.cnsms.res.in

Confocal Raman Microscope

NEW XploRA PLUS V1.2 MULTILINE, Horiba Jobin Yvon

TECHNICAL AND CHARACTERIZATION DETAILS

- Research grade optical microscope –
  Olumpus BX, complete microscope with 2 position motorized white light illuminator Koehler Illumination by reflection (LED eqv 100 W)/transmission (Halogen 30 W) with lamp housings, Abbe condenser and 2 objectives
  20X (NA =0.4WD = 1.3mm), 100 (NA = 0.9 WD=0.21mm)
  50X LWD visible objective (NA = 0.50 WD =10.6 mm)
- Raman spectrometer-
  Integrated imaging spectrometer with 4 gratings mounted on motorized turret with gratings: 600gr, 1200gr, 1800gr and 2400gr)
  HORIBA Scientific CCD detector, TE air cooled (-60°C), 1024x256 pixel, 16 bit,
  Range: 200-1050 nm, QE: ~60% @700 nm @RT
- Laser- Air cooled solid state laser, 532 nm/25mW. Edge and Bandpass filters set at 532 nm for measurements from 60 cm^{-1}
- Spectral resolution -With 532nm wavelength ≤ 1.4cm^{-1}/pixel with 2400 grooves/mm
- Confocal resolution : ≤ 500nm lateral XY (with 532nm)
- Motorized PC controlled 6 position ND filter wheel for laser power adjustment (0.1%, 1%, 10%, 25%, 50%, 100%)
  Motorized PC controlled confocal pinhole
  Motorized PC controlled entrance slit for resolution selection Confocal coupling optics and motorized filter selection
- XY motorized stage, X =75 mm- Y =50 mm. PC controlled by LabSpec software includes Z profiling.
  XY specifications: minimum step size = 10 nm; repeatability =1µm; resolution : 100 nm
- LabSPEC6 spectral software suite for the easy acquisition and analysis of Raman data. Includes control of the hardware and acquisition parameters, AUTO calibration, customizable methods, FLAT fluorescence subtraction, peak label and fit, Image capture, smoothing, spectral subtraction etc.
  Including positioning joystick and an external controller
  SWIFT fast confocal Raman mapping

Contact:resfac@cens.res.in

Electrochemical Workstation

CHI660E, CH Instruments

TECHNICAL AND CHARACTERIZATION DETAILS

- **Functions-**

  Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), Staricase Voltammetry (SCV), Tafel Plot (TAFEL) , Differential Pulse Voltammetry (DPV), Normal Pulse Voltammetry (NPV), Square Wave Voltammetry (SWV), AC Voltammetry (ACV) Second Harmonic AC Voltammetry (SHACV) Hydrodynamic Modulation Voltammetry (HMV)
  Chrono Amperometry (CA), ChronoAmperometry (CA), ChronoCoulometer (CC), Amperometry i-t Curve (i-t), Bulk Electrolysis with Coulometer (BE)
  Sweep-Step Functions (SSF), Multi-Potential Steps (STEP)
  AC Impedance (IMP) – 10uHz to 1MHz, Impedance – Time (IMPT), Impedance – Potential (IMPE), Open Circuit Potential – Time (OCPT), RDE control (0-10V output)
  Full version of CV simulator, Impedance Simulator, IR Compensation
  External Potential Input
  Auxiliary Signal Measurement Channel
  AC Impedance Plots- Bode : log Z vs log (freq), Bode : Phase , vs log (freq), Bode : log Z" & Z' vs log (freq), Bode : log Y vs log (freq), Nyquist ; Z" vs Z', 3D Plots, Admittance; Y" vs Y', Warburg: Z" & Z' vs w1/2 w-angular frequency, Z' vs w Z", Z' vs Z"/w, Cot(phase) vs w ½]

- **Potentiostat-**

  Zero resistance ammeter
  2- or 3- or 4-electrode configuration
  Floating (Isolated from Earth) or earth ground
  Maximum potential: ±10V
  Maximum current: ± 250 mA continuous, ± 350 mA peak
  Compliance Voltage: ±13V
  Potentiostat rise time: < 1 us, 0.8 us typical
  Potentiostat bandwidth (-3dB): 1M Hz
  Applied potential ranges: ±10mV, ±50mV, ±100mV, ±650mV, ±3.276V, ±6.553V, ±10V
  Applied potential resolution: 0.0015 % of potential range
  Applied potential accuracy: ±1 mV, ±0.01% of scale
  Applied potential noise: <10µV rms
  Measured current range: ± 10 pA to ±0.25 A in 12 ranges
  Measured current resolution: 0.0015 % of current range, minimum0.3 fA
  Current measurement accuracy: 0.2% if current range >=1e-6A/V, 1% otherwise
  Input bias current: < 20 pA

- **Galvanostat:**

  Galvanostat applied current range: 3nA – 250mA
  Applied current accuracy: 20pA ±0.2% if >3e-7A, ±1% otherwise
  Applied current resolution: 0.03% of applied current range
  Measured potential range: ±0.025V, ±0.1V, ±0.25V, ±1V, ±2.5V,±10V
  Measured potential resolution: 0.0015 % of measured range

- **Electrometer:**
  Reference electrode input impedance: 1e12 ohm
  Reference electrode input bandwidth: 10M Hz
  Reference electrode input bias current: <= 10 pA @25 deg C
- **Waveform Generation and Data Acquisition:**
  Fast waveform updating rate: 16-bit @ 10 MHz
  Fast data acquisition: dual channel 16 bit ADC, 1,000,000 samples/sec simultaneously
  External signal recording channel at maximum 1M Hz sampling rate
- **Experimental Parameters:**
  CV and LSV scan rate: 0.000001 to 10,000 V/s
  Potential increment during scan: 0.1 mV @ 1,000 V/s
  CA and CC pulse width: 0.0001 to 1000 sec
  CA and CC minimum sample interval: 1 µsec
  True integrator for CC
  DPV and NPV pulse width: 0.001 to 10 sec
  SWV frequency: 1 to 100 kHz
  i-t sample interval: minimum 1 µsec
  ACV frequency: 0.1 to 10 kHz
  SHACV frequency: 0.1 to 5 kHz
  FTACV frequency: 0.1 to 50 Hz, simultaneous acquire 1st, 2nd, 3rd,
  4th, 5th, and 6th harmonics ACV data
  IMP frequency: 0.00001 to 1M Hz
  IMP amplitude: 0.00001V to 0.7V RMS
- **Others:**
  Automatic and manual iR compensation
  Current measurement bias: full range with 16-bit resolution, 0.003% accuracy
  Potential measurement bias: ±10V with 16-bit resolution, 0.003% accuracy
  External potential input
  Potential and current analog output
  Programmable potential filter cutoff: 1.5M Hz, 150K Hz, 15KHz,1.5KHz, 150 Hz, 15 Hz, 1.5Hz, 0.15Hz
  Programmable signal filter cutoff: 1.5M Hz, 150K Hz, 15KHz, 1.5KHz, 150 Hz, 15 Hz, 1.5Hz, 0.15Hz
  RDE control output (Model 630E and up) : 0-10V (corresponding to 0-10000rpm), 16-bit, 0.003% accuracy

Contact: resfac@cens.res.in