R&D Newsletter
INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Special issue on
Advanced Research Equipment
procured under CARE Scheme of IIT Kanpur
Surface Plasmon Resonance (SPR) spectroscopy is a powerful, label-free technique to monitor noncovalent molecular interactions in real time and in a noninvasive fashion. It has, in particular, proven to be a powerful approach for the determination of kinetic parameters (association and dissociation rate constants) as well as thermodynamic parameters, including affinity constants of interacting molecular partners without the requirement of tagging one of the two partners.

Location
Southern Lab -213

Contact
Prof. Manabendra Chandra
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Surface Plasmon Resonance (SPR) Spectrometer
Procurement Year 2014-2015

This spectrometer is suitable for both micro and macro measurements, and offers advanced confocal Raman imaging capabilities in 2D and 3D. Spectrally, the high resolution spectrometer allows subtle sample information such as crystallinity, polymorphism, strain and other band analysis. This combines simple access to very low frequencies down to 10cm\(^{-1}\) with a high throughput single stage spectrometer, using the ultra-low frequency module (ULF). The new generation of notch and bandpass filters allows additional sample characterization to be made in a spectral region rarely available with other basic spectrometers. The spectrometer is also equipped with mapping capabilities.

Location
Laboratory for Spectroscopy at Extreme Conditions (ACMS 107)

Contact
Prof. Rajeev Gupta
guptaraj@iitk.ac.in

User Charges
(per sample)
Rs. 750 (for internal users)
Rs. 1000 (for outside IITK users)
(Service Tax is applicable for outside IITK users)
The DLS Particle Size and Zeta Potential Analyzer is a user-friendly system for colloidal, nanoparticulate and macromolecular characterization. It can determine particle size distribution, particle zeta potential (related to the magnitude of the electrical charge at the particle surface) and molecular weight of large polymeric substances dispersed in water. The significance of zeta potential is that its value can be related to the stability of colloidal dispersions (e.g., a multivitamin syrup). The zeta potential indicates the degree of repulsion between adjacent, similarly charged particles (e.g., the vitamins) in a dispersion. For molecules and particles that are small enough, a high zeta potential will confer stability, i.e., the solution or dispersion will resist aggregation. When the potential is low, attraction exceeds repulsion and the dispersion will break and flocculate. Dynamic Light Scattering (DLS) principle can be used to determine the size distribution profile of small particles in suspension or polymers in solution. It can also be used to probe the behaviour of complex fluids such as concentrated polymer solutions.

**Capabilities**

a) Particle Size and Molecular Size: It can measure size between 0.3 nm to 6 μm with a minimum volume 10 μL of sample suspension. It claims an accuracy of ±2% with a precision of ±1%.

b) Zeta Potential: It can measure wide range of zeta potentials for particles in the size range 1 nm – 100 μm, depending on the type of sample. Minimum sample volume required is 175 μL. It claims an accuracy of 0.12 μm.cm/V.s and a sensitivity of 10 mg/mL (BSA). It can analyse a wide range of suspension concentrations (0.1 ppm to 40% v/v depending on the sample type).

c) Molecular Weight of polymers dispersed in solution: On a sample volume of 10-40 μL, the instrument can determine a range between 1kDa to 25 MDa. Accuracy < ±10%

With this single instrument, the various measurements such as UV/Vis-NIR absorbance, fluorescence, absolute specular reflectance, transmission and scattering at a wide range of angles and different polarizations, and diffused reflectance can be performed. Some of the measurements are unique, for example, variable angle absolute specular reflectance, diffuse scattering, glossy scattering, direct transmission, scattered transmission and partial scattered transmission. The equipment can be used in scientific research related to materials, petrochemicals, energy, food, biotechnology and coating technology.
Visisonics Real Space Audio Camera

**Visisonics RealSpace 5/64 Audio/Visual Panaromic Camera** is a self-contained 64-channel spherical microphone array together with 5 internal HD video cameras that provide seamless panaromic frame synchronized real time audio and video. It is extensively used for sound source localization, noise visualization, noise source identification, Audio/Visual analysis, recording of meetings and Audio/Visual tracking.

**Capabilities**
- Time synchronized 64 channel audio measurements simultaneously in .wav audio format.
- Time synchronized video recordings using 5 HD cameras in .avi video format.
- 360° panaromic display.
- Generates a video of acoustic energy intensity in a frequency band
- Real time beamforming.
- Order tracking and coupled acoustic visualization.

**Location**
MiPS Lab, ACES - 203
Dept. of Electrical Engineering

**Contact**
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**More Info Available @**
http://202.3.77.107/mips

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Multi - Channel hdEEG g-tech Setup

**g.Hlamp** is g.tec's multi-channel high-end biosignal amplifier with USB technology. The device allows the acquisition of up to 256 biosignal channels such as EEG (Electroencephalogram), EOG (Electrooculogram), EMG (Electromyogram) and ECG (Electrocardiogram) with 24 bit. The sampling frequency can be set up to 38400 Hz. In addition to the above the device also has skin temperature sensor, GSR sensor to measure electro-dermal activity.

**Location**
Western Lab 216B
Dept. of Electrical Engineering

**Contact**
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Mr. Tharun Reddy
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Mr. Ashish Gupta
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A Solar Simulator is a light source that approximates the illumination of natural sunlight. Solar simulators with various tailored spectral output are used to test a variety of samples including but not limited to solar cells, materials photo-stability, and other samples (in-vivo or in-vitro) under controlled, repeatable, laboratory conditions. OAI Solar Simulator is certified for Class AAA performance having aperture sizes of 156 mm × 156 mm for 0-4 SUNS with long working distance (~22 inches). It has CPVLD50 adaptor light pipe for 20 SUNS (aperture size: 45 mm × 45 mm) and 50 SUNS (aperture size: 25.4 mm × 25.4 mm) measurement (working distance of ~2 mm). The equipment uses I-V-Rider software which record I-V data in both forward and reverse sweep directions. It also allows calculation of various solar cell parameters such as short circuit current (I_\text{sc}) , short circuit current density (J_\text{sc}) , open circuit voltage (V_\text{oc}) , maximum voltage (V_\text{max}) , maximum current (I_\text{max}) , maximum power (P_\text{max}) , cell efficiency, series resistance (R_s) and shunt resistance (R_sh).

Quantum efficiency (QE) and Incident Photon to Charge Carrier Efficiency (IPCE) indicates the ratio of the number of photons incident on a solar cell to the number of generated charge carriers. Oriel Instrument's IQE-200 series system measures the External Quantum Efficiency (EQE) and Internal Quantum Efficiency (IQE) of solar cells, detectors, or other photon-current devices. It covers the spectral ranges of 300 – 1100 nm and 300 – 1800 nm, for both AC and DC operation.

Location
Room No. 120
CESE (Center for Environmental Science and Engineering)

Contact
Prof. Raju Kumar Gupta
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Mr. Rahul Ranjan
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The main equipment consists of Zeiss AxioObserver Z1 inverted research microscope and Zeiss LSM710 confocal scan head. Currently, we have Plan Apochromat 20X/0.80NA, 63X/1.40NA objectives with DIC accessories and 1.4 mega pixel CCD camera. The microscope has the following excitation lasers:

- Multiline Argon 458/488/514 nm - 25mW
- HeNe 543 nm - 1.2mW
- HeNe 633 nm - 5mW
- Diode 405nm - 30mW

In addition, we are in the process of acquiring an optical trapping system with 1064nm trap laser from Elliott Scientific. The trapping system will be integrated with the microscope. The expected date of the installation of the trapping unit is December 2015.

The laser unit is a dual head diode-pumped laser. The laser head is designed on a monolithic platform. Its energy per pulse is 30 mJ at 1kHz repetition rate, and the duration of a pulse is about 170 ns. The beam diameter is approximately 5 mm. The whole laser unit comprises of a chiller unit for cooling the laser head, two laser controllers, light arm and light sheet optics. This instrument is synchronized with a high frequency double exposure camera for time-resolved particle image velocimetry measurements in a fluid flow.
**Gasoline Direct Injection Engine**  
*Procurement Year 2013-2014*

This engine has an open ECU which can be programmed depending on the type of experiments to be performed. Spark timing, fuel injection timing can be varied with the help of this ECU. The engine has higher efficiency and higher power output because it can work in both stratified mode and homogeneous charge mode. This GDI engine can be operated in thermal head and optical head. Optical investigation can also be performed within this engine using different optical diagnostic technique such as Phase Doppler Interferometry (PDI), and Time resolved Particle Imaging velocimetry (PIV).

This engine is 500 cc, Bore: 86 mm, Stroke: 86 mm, Compression Ratio: 10.5:1, Maximum power: 10 KW@3000 RPM, Maximum torque 32NM @ 3000rpm.

**Location**  
Engine Research Laboratory,  
Workshop complex

**Contact**  
Mr. Nikhil Sharma  
snikhil@iitk.ac.in

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**DC/RF Magnetron Sputtering System Facility for Thin Film Deposition**  
*Procurement Year 2013-2014*

This is a confocal thin-film deposition tool in sputter-up configuration, equipped with three RF/DC magnetron guns. Dielectric materials such as SiO₂, TiO₂, ZnO, Al₂O₃, and metal films such as Au, Ag, Pt, Cu and Zn can be deposited. Target to substrate distance is adjustable to achieve desired uniformity and deposition rate. The system can process wafers up to 2” in diameter. With its multi-gun capability, co-sputtering, sequential sputtering and reactive sputtering (with active gas mixtures) are possible.

**Location**  
Southern laboratory 116  
(ground floor)

**Contact**  
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**More Info Available @**  
http://www.iitk.ac.in/celt/CELT/Magnetron%20Sputtering/index.html
Characterization of porous materials and gas sorption analysis:
- To determine BET or Langmuir surface areas
- Pore size analysis
- Total pore volume and average pore radius
- Physisorption isotherms with the N₂, H₂, Ar and CO₂ gases

**User Charges**

<table>
<thead>
<tr>
<th>Service</th>
<th>IITK Users</th>
<th>Non-IITK Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>BET surface area analysis (12 hrs. slot)</td>
<td>INR 1000</td>
<td>INR 2000</td>
</tr>
<tr>
<td>Physisorption isotherms (12 hrs. slot)</td>
<td>INR 2000</td>
<td>INR 3000</td>
</tr>
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(Service Tax is applicable for outside IITK users)

**Quantachrome High Pressure Gas Sorption Analyzer**

It is a volumetric gas sorption analyzer for performing gas sorption analysis (adsorption, adsorption-desorption and formation or decomposition of hydrides in analytes) of porous solids or powders up to 0-100 bar with H₂ and CO₂ gases.

**Location**

Old Core Lab - 204A
Department of Chemistry

**Contact**

Prof. J.N. Moorthy
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**User Charges**

High pressure gas absorption isotherms (12 hrs. slot)
- IITK Users: INR 3000
- Non-IITK Users: INR 5000

(Service Tax is applicable for outside IITK users)