

ADVANCED ENERGY MATERIALS & SYSTEMS LABORATORY

Advanced Energy Materials & Systems (AEMS) Lab was established in 2013 with funding from NUST, HEC and a USAID-funded project. The Lab is one of a kind lab, equipped with facilities for materials' modelling/simulation, processing, sample preparation, coatings, device fabrication, and characterisation. It is fully geared up to solving the problems of industries such as Steel, Auto-manufacturing, Chemical, Petrochemical, Surgical, Defence and Tool Manufacturing. In AEMS Lab, materials development through wet chemical, solid state, and vapour phase deposition techniques are frequently practiced. Different types of ball milling machines and hydrothermal reactor are often employed for nano powders and nanocomposites development. Several coating techniques for film deposition like spin coating, dip coating, electrophoresis, nanofiber electrospinning, ultrasonic spraying, thermal & e-beam evaporation, reactive sputtering, chemical vapour deposition and thermal spraying are available. A number of heat treatment facilities for thermal treatment at different temperatures and in different atmospheres are integral part of the AEMS Lab. Facilities like hydraulic press, sand blasters, lapping, grinding & polishing tools, diamond saw cutter, and plasma cleaner are often employed for sample preparation and other such practices. The characterisation facility offers a broad range of tools for the morphological, chemical, electrical & electronic, structural, and thermal behaviour of different material systems and devices.

LAB MISSION

To develop highly efficient and environmentally benign materials for sustainable energy needs of Pakistan.

RESEARCH PORTFOLIO

- Solar Cells
- High-Temperature Fuel Cells
- Thermal Barrier Coatings
- Anti-Reflective Coatings
- Batteries
- High heat flux and radiation tolerant materials



RESEARCH EQUIPMENT

Equipment	Description	Specification
Scanning electron microscope with energy dispersive X-ray spectroscopy	Highly resolved morphological images at the nanoscale are obtained and elemental composition of the sample is traceable with the EDS detector fitted with the system.	Accelerating voltage: 200 V to 30 kV
X-ray diffractometer	To extract and analyze the crystal structure and phase information of different materials.	Cu Ka radiations with LYNXEYE 1-D detector
Atomic Force Microscope	To develops a sub nanometrically precise topographical image of a surface	Linear electromagnetic scanner with deviation less than 0.1% over the full scan range.
Thermal dilatometer	The relative change in length as a function of temperature.	Sample length: 0-50 mm Sample diameter: Max. 10 mm Temperature upto 1500 °C max.
Simultaneous Thermogravimetric/ Differential Thermal Analyzer (TG/DTA)	TG/DTA can measure the weight loss as a function of temperature and useful information such as the temperature of crystallization or pyrolysis temperature can be extracted.	Sample length: 0-50 mm Sample diameter: Max. 10 mm Temperature upto 1500 °C max.
Simultaneous Thermogravimetric/ Differential Thermal Analyzer (TG/DTA)	TG/DTA can measure the weight loss as a function of temperature and useful information such as the temperature of crystallization or pyrolysis temperature can be extracted.	Temperature range: Ambient -1500 °C Measurable range (TG): ± 500mg Measurable range (DTA): ± 1000 μV
UV-Vis-NIR Spectrophotometer	Information about the optical response, thickness estimation, electronic band structure, etc.	Transmittance measurements of solids as well as liquids, in the range of 200 – 3200 nm
Hall Effect Measurement System	It is a complete system for measuring the resistivity, carrier concentration, and mobility of semiconductors.	Precise Constant current source: 1nA to 20mA range.
FTIR Spectrometer	FTIR spectrometer is a versatile tool for the chemical analysis of solids, powders, liquids, and pastes	Spectral range: 4000 cm ⁻¹ to 650 cm ⁻¹
Surface Area and Pore Size Analyzer	NOVA 2200e is a simultaneous rapid two-sample surface area and pore size analyzer.	Analyze up to 200 data points
Microhardness Tester (FM-810, Future-Tech Corp., Japan)	Vickers hardness (HV) and Knopp hardness (HK) measurements possible	Test loads (gf): 5, 10, 25, 50, 100, 200, 300, 500, 1000, 2000