Global Initiative on Academic Networks (GIAN) Program

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PHOTOELECTRON SPECTROSCOPY FOR MATERIAL SCIENCE

Course Dates: 31st Jan - 4th Feb 2022

Ministry of Education
Goverment of India

INFORMATION

REGISTRATION CLOSING DATE	VENUE
25 January 2022 (40 Participants only)	Materials Research Centre Malaviya National Institute of Technology Jaipur, India

OVERVIEW

Modern material applications demand precise control of surface chemistry of bulk materials and thin films used as catalysts or functional surfaces. Typical surface specific applications are well demonstrated in nanomaterials, photovoltaics, catalysis, corrosion protection, adhesion promotion, electronic devices and packaging, magnetic media, display technology, surface treatments, surface modifications and thin film coatings used for numerous applications. The precise control and characterization of surface chemistry is extended beyond typical technical applications to biology. Nowadays, the bio-systems extensively investigated and applied are biosensors, where the surface functionalization by numerous molecules plays a critical role in dictating its functionality.

X-ray Photoelectron Spectroscopy (XPS) also known as Electron Spectroscopy for Chemical Analysis (ESCA) is the most widely used surface analysis technique. XPS can be applied to a broad range of materials and provides valuable quantitative and chemical state information from the material's surface under investigation. It is a surface sensitive technique where the average depth of analysis is limited within 10 nm. It is in contrast to SEM/EDS techniques which have a typical analysis depth of 1-3 μm. The spatial resolution depends on the machine and it is not unique to reach 10 nm. XPS is typically accomplished by exciting a sample surface with x-rays from Al, Mg, Ag anodes causing photoelectrons to be emitted from the sample surface. An electron energy analyser is used to measure the kinetic energy of the emitted photoelectrons. The elemental identity, chemical state, and quantity of a detected element can be determined from the binding energy and intensity of a photoelectron peak. The method can be enhanced by an additional ion source for the sputtering which makes depth profiling also a possibility. But there are limitations due to the sputtering induced chemical changes. Changing the X-ray wavelengths to UV range, the ultraviolet photoelectron spectroscopy (UPS) method can be used for valence band investigations.

Another variant, Auger spectroscopy (AES), can be utilized to investigate materials, by merely substituting photon excitation source with electrons having energy in the keV range while keeping the same electron analyser in use. It is well known that it is easy to focus electrons, therefore such combination machine can offer higher spatial resolution (tens of nm) in AES mode as compared to lower spatial resolution in XPS mode. Each technique have different sensitivity to various chemical bonds. It is beneficial to use multiple techniques to understand the investigated materials and system better. Therefore, it is the need of the hour to learn such techniques and utilize the knowledge to analyse the surface sensitive material systems.

Objective

The course objective is to provide the participants with today's detailed on the main problems arising during the characterization of materials by XPS and p oint out some problems connected to UPS and AES techniques. The first parts of the course are devoted to the theory and basics of the methods, all demonstrated on many characteristic examples. The second part is devoted to more advanced and combined methods followed by short practical tutorial of software usage and the last part is devoted to practical laboratory exercise.

Who Can Attend

- Faculty members from reputed academic institutions.
- Research scholars and postgraduate students from academic and technical institutions.
- Industry experts.

The course is addressed to scientists, professionals, company engineers, R&D managers and graduate students in the fields of Engineering, Chemistry, Physics, Applied and Fundamental Sciences. This course is especially of interest to those dealing with phenomena involving applications where surfaces play crucial role.

e-Certificate

Participation certificate will be given to all the participants.

Course Fees

The course will be online/hybrid for participants including the lab demonstration whereas all lectures including tutorials by expert will be delivered virtually.

- Participants from abroad: US$50
- Industry/Research Organizations: Rs.5000 /-
- Faculty from Indian academic Institutions: Rs.2500 /-
- Research Scholars and students: Rs.1000/

The Registration fee covers the cost of lectures, tutorials, demonstrations, course material. Participants may avail on-campus accommodation on payment basis (subjected to government/ institute guidelines). No TA/DA shall be provided to participants.

How To Register

One Time Registration at GIAN portal of IIT Kharagpur is mandatory for every participant. Follow the instruction at https://gian.iitkgp.ac.in/GREGN/index to register and pay Rs. 500 fee. Next register for course at Institute registration link (https://forms.gle/d4ZVGuG59sCRkrVw9). Fees for the course can be paid through National Electronic Transfer (NEFT), to the account of "Registrar, MNIT Jaipur" (Account No.:676801700388 ICICI Bank, Branch MNIT Jaipur, IFSC Code: ICIC0006768. Please email a scanned copy of the NEFT and duly filled signed registration form to Dr. Nisha Verma at nisha.mrc@mnit.ac.in.

International Expert

Martin Kormunda is full associate professor and head of department of experimental physics in J.E. Purkyne University in Usti nad Labem, Czech Republic. In 2002, he received his Ph.D. from West Bohemia University in Plasma physics and thin films science, with thesis on hard coatings prepared by magnetron sputtering. Then he joined Research Center of European Commission in Ispra, Italy for 2 years in group of Biomaterials and systems. Then he spent almost 3 years in industry, from 2005 to 2007, as Head of research unit in PRECIOSA-LUSTRY, leading company for luxury chandelier and later as Senior Quality Manager for the plant. Then he joined J.E. Purkyne University in middle of 2007 where he is till date holding the post of lead scientist in surface characterizations and plasma related material processing. His field of research and publications is much diversified as e.g. on materials and surface engineering, structural transformations, deposition and characterization of thin films, tribology, nanocrystalline / nanocomposite materials. His main interest in last 10 year is XPS for material science. He has leaded about 15 Masters Students and 3 PhD students.

He published more than 80 papers in international journals. He has more than 1000 citations and an H-index of 19 (Web of Science).

Course Coordinator

Dr. Nisha Verma
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Course Co-Coordinator

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