Advanced X-ray diffraction techniques for the characterization of materials - 176020M01

January 17 th to 25 th 2018 at Anna University, Chennai

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Overview

In the preparation of crystalline materials and semiconducting crystals for electronic or optoelectronic applications, such as silicon, gallium arsenide, gallium nitride, silicon carbide and the corresponding devices such as transistors, lasers, light emitting devices, solar cells it is of paramount importance the characterization of the crystal quality, of the compositions and of the residual strain.

High resolution x-ray diffraction techniques, based on monochromatic, collimated x-ray beams can be employed for the accurate characterization of a large class of materials.

In the present course the basic of the theory of x-ray scattering will be reviewed reporting the important results of kinematical and the dynamical theory of x-ray diffraction. Several methods for the x-ray characterizations, such reciprocal lattice maps, reflectivity, polar maps, powder diffraction, and thin film characterization will be introduced and several examples will be reported.

Duration Course Code & Venue	**Date: 17 th January 2018 - 25th January 2018 (includes 18 hrs. of lectures and tutorials)** **Course Code: [176020M01]** **Venue: Crystal Growth Centre, Anna Number of participants for the course will be limited to hundred.**
Modules	• Scattering of X-ray by an electron; Scattering of x-rays by distributed charge; Fourier Transform of the Electronic Charge Distribution in Crystals; Charge Density in Unit Cell; Polarizability; Diffracted intensity from a small crystal (Laue equations);FWHM of the diffraction peak; Integrated intensity in an absorbing crystal; Polarization;Electromagnetic Wave in Periodic Medium • Maxwell Equations; Basic Equations for Dynamical Theory; Bloch waves inside the crystals; two beam approximation; Dispersion surface ;Tie points on the dispersion surface;Takagi Taupin equations; Dynamical theory of X-ray diffraction:;Bragg geometry; Diffraction profiles in Bragg geometry; Effect of asymmetry in Bragg geometry • High resolution X-ray diffraction techniques; Double crystal X-ray diffractometry; Bartelmonochromator-high resolution X-ray diffraction; Du Mond diagrams; Bartels monochromator-channel cut crystals; Simulation of X-ray diffraction profiles; Calculation of composition in a thin film;Measurement of strain and stress in a thin film • Method of X-ray reflectivity; Method of polar maps; Thin film and powder diffraction **Tutorials** • Introduction to the use of the diffractometer; Measurement of effect of asymmetry to the diffracted intensity and to the full width at half maximum (FWHM) in perfect crystals; High resolution X-ray diffractometer using a Bartels monochromator; Asymmetrical profiles; Difference between acceptance profile and exit profile. • Measurement of an epitaxial heterostructure or of a superlattice using a high resolution X-ray diffraction. • Use of simulation programs to retrieve parameters of thin films after high resolution
You Should Attend If…	▪ You are a student (B.Tech/M.Sc/M.Tech/PhD), a post-doctoral fellow ▪ Faculty from reputed academic institutions and technical institutions. ▪ The participation of executives, engineers, and researchers from manufacturing, service and government organizations including R&D laboratories is also strongly encouraged.
Fees	The participation fees for taking the course is as follows: **Participants from abroad : US $500** **Industry/ Research Organizations: Rs. 5000** **Academic Institutions: Rs. 2000 (Faculty) 1000 (Research Scholars/PG and UG Students)** The above fee includes all instructional materials. The participants will have to take care of their travel, accommodation and food.

The Faculty

Dr. Claudio Ferrari is the Group Head and a Senior Researcher at the Institute of Materials for Electronics and Magnetism of the National Research Council of Italy.

Claudio Ferrari is senior researcher at IMEM-CNR Institute and is a recognised expert in the field of x-ray diffraction for the x-ray characterization of semiconductor heterostructures, in the study of crystallographic defects using x-ray topography and in the study of components for focusing x-rays based on diffraction. More recently he is using his expertise for studying materials and devices for photovoltaic energy.

He is author of more than 180 papers on international journals, 7 invited contributions on international volumes, editor of a book collecting the papers of the XTOP conference 1996 on high resolution x-ray diffraction and topography. He is author of 4 international patents.

He was selected as evaluator of several European and national projects.

He has been responsible of several national and international research projects and is actually leader of a research group at IMEM Institute. From 2008 he has been responsible of a national projects for realizing x-ray optical elements based on crystal diffraction for hard x-ray astronomy (total amount of the project 2.2 mil €).

Although teaching is not the main task in a research institute such as IMEM he gave several courses at Parma University since 2002: “Dynamical theory of x-ray diffraction in perfect and curved crystals”. PhD in “Science and Technology of Innovative Materials”, “Laboratory of characterization techniques” within the PhD course in Science and Technology of Innovative Materials, “Laboratory of diagnostic techniques” , "X-ray diffraction techniques” at the department of Physics of Parma University

Dr.J.Kumar is the Director of Planning & Development and Professor of Crystal Growth Centre, Anna University. He is also local coordinator of GIAN, Anna University. His area of specialization includes MOCVD, Semiconductor Crystal: Growth, Characterization and Device Fabrication.

Course Co-ordinator

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