MODERN METHODS OF MATERIALS CHARACTERISATION

CH-VADD1

Course Duration: 30 hrs

Course Objectives

Materials Characterization has gained enormous importance in diverse fieldsin which the chemical, microstructure and physical properties of different materials are probed, measured and determined using a variety of analytical methods, techniques and tools.

The course aims to provide the student with an overview of the current techniques used for the physicochemical characterisation of materials with special reference to the principles, practice and applications of X-ray diffraction, spectroscopic, microscopic, thermal and electroanalytical techniques..

Learning Outcomes

On successful completion of this short term course, a student will be able to:

- Explain the principlesand operation of a range of advanced techniques such as X-ay, spectroscopic, microscopic, thermal and electroanalytical, currently used in characterisation of various materials and compounds.
- Hand on experience of operation of some these instruments at labs and interpretation of results.
- Apply the skills gained in future course of research in materials science

Course Syllabus

Module -1

X-ray techniques for materials characterization

X-ray diffraction: Principle, measuring system and applications for characterization of powdered materials. X-ray diffraction profile and analysis: FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform)

Introduction to Extended X-ray absorption fine structure (EXAFS), Surface extended X-ray absorption (SEXAFS).

Module - II

Microscopic techniques

Principles, instrumentations and applications of Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) for characterization of different samples. Energy dispersive X-ray microanalysis (EDS) -

Basic aspects of Atomic force microscopy (AFM).

Module - III

Spectroscopic methods

Principle, instrumentation and applications of UV-Visible Diffuse Reflectance (UV-Vis DRS) spectroscopy, Ft-Ir, Raman and Fluorescence spectroscopy.

Hand of experience on operation of UV-Vis-DRS, FT-IR, Raman and data analysis..

Module-IV

Thermoanalytical Methods

Principle, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Temperature Analysis (DTA) and Differential Scanning Calorometry (DSC).
Factors affecting the TGA/DTA/DSC results and their interpretations.
Hand on on experience of operation of TG/DSC and data analysis.

Module-V

Electroanalytical Techniques

Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms.
Hand on experience on operation of CV and data analysis.

Books Recommended

1) Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
2) Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
3) Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.
4) Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
5) Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
6) Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.