Surface engineering. characterisation and modification

Surface engineering, characterisation and modification includes spectrum evaluation and data interpretation. Ion beams from protons to gold are available for materials analysis, nuclear and atomic physics studies. Ion beam energies up to 100 MeV are available, with atoms having either partially or fully stripped electron shells. Ion energy and charge state depends on ion species and accelerator terminal voltage.

Facilities include UHV vacuum chamber with 3D XYZ target manipulator, ability to cool and heat targets during analysis, range of charge particle detectors, and gamma and X-ray spectrometers.

Applications include measurement of carbon, nitrogen and oxygen by inelastic proton scattering, near surface profiling, hydrogen depth profiling and nuclear structure studies.

Please discuss your proposal with the appropriate ANSTO Contact Scientist before submitting as they will assist you in making the correct capability selection.

Capability Selections

- Elastic Recoil Detection Analysis - Time of Flight (ERDA-ToF)
- High Energy Heavy Ion Microprobe Analysis
- Single and Low energy ion implantation and in-situ depth profiling
- Low energy and High energy simultaneous ion implantation
- Low energy (< 50kV) and High energy ion implantation
- Ion Beam Induced Charge (IBIC)
- Radiation damage of materials
- Crystallographic ion channeling analysis
- Particle Induced X-ray Emission spectrometry (2D, 3D PIXE)

Elastic Recoil Detection Analysis - Time of Flight (ERDA-ToF)

Simultaneous element depth profiling of the composition of multi-layered thin films, and of the near surface region of bulk materials using high energy, heavy ion forward recoil spectrometry. A heavy ion beam incident on a target material ejects atoms from the surface region, which are subsequently mass identified by a measurement of particle energy and velocity.

Mass separated particle yield vs energy profiles are obtained which are translated to concentration vs depth profiles. Applications include interfacial stoichiometry in semiconductor devices, solar cells, optical coatings and metallised polymers.

Facilities include ultra high vacuum chamber (UHV) with XYZ target manipulator, cryogenic vacuum pumping, multiparameter data acquisition system and graphical analysis software and data interpretation.

High Energy Heavy Ion Microprobe Analysis

Microanalysis of the first few microns of the surface region of materials by ion beam analysis can provide good elemental sensitivity and depth resolution. The quantitative determination and localisation of elements in modern high technology materials and devices such as semiconductors, optoelectronics and sensors, critically depends on the composition and interactions of multi-layer thin film coatings.

The use of high energy, heavy ion beam techniques permits analysis of these structures, which are often impossible to characterise satisfactorily by other, low energy methods. Examples include metal-polymer, metal-ceramic adhesion studies, optical coatings on glass, high speed semiconductor memory chips and the characterisation of surface modified materials produced by plasma processing, chemical or ion implantation.

The use of high energy light ion beams permits a wide range of nuclear reactions and techniques to be used for element specific studies, such as hydrogen and oxygen in corrosion, lithium in aluminium-lithium alloy materials, carbon from lubricants in wear, and nitrogen in nitrided cutting tools.

Single and Low energy ion implantation and in-situ depth profiling

XYZ Target Manipulator - UHV target chamber with charged particle detectors for depth profile measurements of light elements such as hydrogen, carbon and oxygen, using forward recoil and nuclear reaction techniques. This has a target positioning stage with precise 3D X, Y and Z movement. These have been used for study of water turnover in desert lizards using ^{18}O as a biological tracer, depth profiling of ion implanted species, metallised contacts on semiconductors near surface hydrogen profiling in solar cells. The number of running days required to successfully complete each project should be discussed with the ANSTO Contact Scientist.

Low energy (<50kV) and High energy ion implantation

Implanted ions with energies from keV to 100 MeV from hydrogen to gold can be used to modify surfaces and materials and change the properties of materials.

Ion Beam Induced Charge (IBIC)

Ion beams from accelerators deposit charge when stopped in materials like silicon or germanium detectors. This charge produces a signal that can be related to the dose an ion gives to the detector.

Radiation damage of materials

Ion beams particular MeV proton and alpha beams can be used to produce radiation damage in a range of solid materials both on the surface and at depth.

Crystallographic ion channeling analysis

Crystals, because of their ordered structure have defined channels or directions through them. Ion beams can be directed along these channels to identify doped atoms within crystal structures.

Particle Induced X-ray Emission spectrometry (2D, 3D PIXE)

Ion beams from our accelerators can be scanned in two dimensions perpendicular to the beam and this, together with precise target manipulation along the beam directions means that 2D and 3D images can be produced. X-rays induced by the ion beams for a range of elements from aluminium to lead can be utilised to produce these multi-dimensional elemental maps.

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