Managing Authority and Funding

FCT Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

Plano Nacional de Re-equipamento Científico

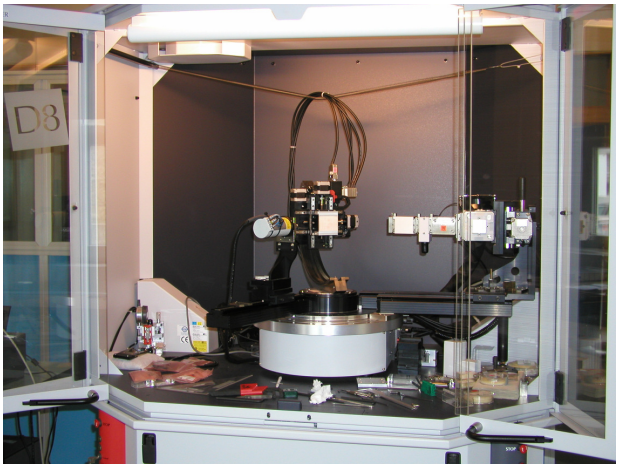
Project Reference: REEQ/814/CTM/2005

Designation: Upgrade and installation of a Small Angle Scattering X-ray Spectrometer (SAXS) at the MA3T Laboratory and the 3 MV Tandem Accelerator at the Ion Beam Laboratory (IBL).

Responsible Researcher: Eduardo Alves (ealves@itn.pt)

Access to the equipment: The equipment is available to the scientific community both through collaborations within the framework of research projects or technical services. In the later case, consumables and running costs will be charged to the users.

MA^{3}T Laboratory



View of the new diffractometer installed at the MA3T x-ray laboratory.

Important features of the new equipment:

The new equipment consists of a D8Discover high resolution x-ray diffractometer with Ultra GID (in-plane Grazing Incidence Diffraction) included. This equipment uses the Cu $K_{\alpha 1}$ radiation collimated with the last generation of Göbel mirrors providing a high flux x-ray parallel beam. This feature combining with the 8 high resolution axes goniometer (0.0001 º resolution for θ and 2θ axes) and several different geometries using different monochromators and slits type, allows to cover a large number of x-ray diffraction techniques either using high resolution or high intensity.

High flux beam is used for polycrystalline materials characterization, such as phase analysis, texture and reflectometry either for bulk material or thin films.

The most important applications use high resolution and are dedicated to study nanostructured materials, such as multilayered materials, quantum dot, quantum wires, etc..

The diffractometer allows a detailed characterization of composition, strain and thickness on multilayered materials namely on semiconductor alloys, using high resolution Rocking Curves, Reciprocal Space Maps and Reflectometry techniques combining with a simulation and fitting software.

For nanoparticles characterization more detailed information can be obtained, like size, shape and distribution using non conventional techniques such as SAXS or GID. This last technique is also a powerful tool to study ultra thin films with a thickness in the range down to some nanometers, as well to study strain profile along the layer depth.

Ion Beam Laboratory

Ion Beam Laboratory (IBL) is equipped with a 2,5 MV Van de Graaff accelerator with a nuclear microprobe, a 210 kV high fluence ion implanter and a 3 MV Tandem accelerator with an Accelerator Mass Spectrometry (AMS) Line.

General view of the 3 MV Tandem accelerator equipped with an accelerator mass spectroscopy (AMS) system with a lateral resolution of 30 μm.

Important features of the equipment/facilities:

The accelerator is a 3 MV General Ionex Tandem by High Voltage Engineering Corporation, Europe, with a NEC Alphatros ion source for He beams and a negative ion direct-extraction Duoplasmatron ion source for H-beams.

<u>The experimental lines include a:</u>

PIXE Line: high resolution high energy PIXE line equipped with two detectors, a CdTe detector from Amptek Inc. ranging from 3 keV up to 120 keV and a POLARIS, EDS microcalorimeter x-ray detector, from Vericold Technologies GmbH, which energy range covers from 1.0 keV up to more

than 20 keV, and presents as benchmarks, 15 eV resolution at 1.480 keV energy of Al Kalpha line, and 24 ev at 10.551 keV energy of Pb Lalpha line. See further details at http://lceamirror.se.itn.pt/ [REEQ/377/FIS/2005].

Multipurpose RBS/Channeling Line: under installation.

Nuclear Experimental Physics Line: equipped with a hyper pure γ-ray Ge detector and other solid state detectors for nuclear reaction studies.

AMS Line: The AMS system includes micro-focused Cs beam unique in the world. The sputter source is a General Ionex model 834 Hiconex with a 12 cone target rotating target magazine, a Cs reservoir, a W ionizer frit and with intermediate focusing and steering control on the Cs beam (controller for focus/steerer rebuilt for better control and stability). Rated currents include H^- 2 µA, C^- 20 µA, Si^- 10 µA, O^- 20 µA, Cu^- 2 µA using the normal cone targets or an inert target cone and a gas bleed. For use in the Australis AMS target chamber source, the Hiconex has been used with modified cones to act as source apertures. This source is then refocused down onto a sample into a spot size of ~30-300 µm (8 nA at 100 µm). This system is described in papers by Sie et *al*.: NIMA 382 (1996) 299 and NIMB 123 (1997) 558.