

Advanced Materials Research (GIMA)

Eduardo Alves

The Advanced Materials Research Group is responsible for the **Ion Beam Laboratory (IBL)**. The laboratory is equipped with a 2.5 MV Van de Graaff accelerator and a 210 kV High fluence Ion Implantor. Two other facilities are installed and running at ISOLDE/CERN, in collaboration with CFNUL, comprising two **emission channelling lines** and one **hyperfine interaction laboratory**.

The Group activities are centred on the processing and characterisation of advanced materials using ion beam based techniques. The work carried out during the last two decades allowed the group to achieve a large expertise on the field of Ion Beam Applications to Material Science. The recognition of the work is well patented by the large number of national and international collaborations. Most of these collaborations started through bilateral contracts and some of them are still running, namely with the universities of Seville, Bonn and Knoxville (USA).

It is also worth to note the number of projects, both European and National, with the participation or led by members of the group.

The combination of Ion Beam and Hyperfine Interaction (HI) techniques provided us with a powerful tool to explore, modify and model the behaviour of new materials. Lately the research activities of the group were focused in two kinds of materials: **Semiconductors and Insulators**. Studies in semiconductors include the doping of **GaN** and **ZnO** with optically and electrically active ions. These two wide bandgap semiconductors are under intense research all over the world due to the possibility of developing optoelectronic devices working in the visible wavelength range of the electromagnetic spectrum. Our work aims at the optimization of the implantation conditions of the dopants. Other relevant research work is being carried out in quantum well structures. An intense study of the structural properties of GaN/InGaN structures is under way in collaboration with the University of Aveiro and Strathclyd.

The work in insulators is a continuation of ongoing projects or bilateral collaborations to modify the optical and electrical properties of $\alpha\text{-Al}_2\text{O}_3$ and **laser materials** (KTP and RTP). A bilateral project with the University Carlos III in Spain continues the study of the doping of MgO and TiO₂ with transition metals. Besides this and due to the potential of ion beam techniques to study thin films and multilayers, important work has been continued in the characterisation of **magnetic thin films for magnetic spin valves and tunnel junctions**. The activity in the technology programme of the **European Fusion Development Agreement (EFDA)**, in association with the Centro de Fusão Nuclear of the Instituto Superior Técnico continued.

Structural studies of the new Eurofer(ODS) steel are under way as well as the oxidation behaviour of Beryllides. Finally, the group maintains an experimental infrastructure at the **ISOLDE/CERN** radioactive ion beam facility where the Emission Channelling (EC) technique is, applied to studies of lattice site location of impurities in semiconductors and insulators. In addition Perturbed Angular Correlations are used to characterise the charge carrier blocks and charge ordering in High-Tc superconductors and on colossal magnetoresistive oxides. A project is running new fast 2D- Si electron PAD detectors to extend the use of EC to probe elements only available by using short-lived isotopes (like ²⁷Mg).

Besides these research activities the group is also strongly engaged in training graduate and undergraduate students, through the supervision and work of M.Sc. and Ph.D. students, Final year degree thesis and Socrates Students as well. In 2004, 68 papers were published in international Journal, 40 accepted for publication and two researchers were awarded with the “**Estímulo à Excelência**” prize. The main achievements of the research developed in 2004 are summarised in the following pages.

Advanced Materials Research

Research Team

Researchers

- E. ALVES, Auxiliary researcher, Group leader
- R.C. da SILVA, Auxiliary researcher
- L.C. ALVES, Research assistant (75%)
- J.G. CORREIA, ITN, Invited Researcher
- N. BARRADAS, Auxil. researcher, Reactor (20%)
- A.R. RAMOS Auxiliary researcher, Reactor (15%)
- A. KLING, Auxiliary researcher, Reactor (10%)
- M.R. DA SILVA Auxiliary Prof., IST
- U. WAHL, FCT Post-Doctoral,
- K. LORENTZ, EC Post-Doctoral
- V. CORREGIDOR, EC Post-Doctoral

Students

- J. VAZ PINTO, Ph.D. student, FCT grant
- E. RITA, Ph.D. student, Univ. Lisboa, FCT grant
- C.P. MARQUES, Ph.D. student, FCT grant
- A.C. MARQUES, Ph.D. student, FCT grant
- N. FRANCO, Ph.D. student, FCT grant
- A. FONSECA, Ph.D. student, Project grant
- A. GOUVEIA, Research Project grant

Technical Personnel

- J. ROCHA
- F. BAPTISTA
- P. PEREIRA
- L. SEQUEIRA

Funding (€)

Research Projects:	57.400,85
Services:	0
Total:	57.400,85

Publications

Journals:	65 and 31 in press
Proceedings:	6
Conf. Communications:	34
Other publications:	2
Theses: Ph.D.	1