
ADVANCED MATERIALS RESEARCH (IBL)

Annual Activity Report 2013

UNIT: Physics and Accelerators

TEAM

Name	Category	R&D (%)
Eduardo Jorge da Costa Alves	Principal Researcher	100%
Rui Manuel Coelho da Silva	Principal Researcher	100%
Katharina Lorenz	Auxiliary Researcher (Ciência 2007) until February 2013; Voluntary Researcher March-August 2013; Principal Researcher (FCT), since September 2013.	100%
Carlos Marques da Cruz	Auxiliary Researcher	100%
Luís Cerqueira Alves	Auxiliary Researcher	30% (70% IRT)
Victoria Corregidor	Auxiliary Researcher (Ciência 2008)	100%
Nuno Franco	PostDoc Researcher	100%
Andrés Redondo-Cubero	PostDoc Researcher	100%
Ana Cláudia	PostDoc Researcher	100%
Marta Dias	PostDoc Researcher	100%
Rui Martins	PostDoc Researcher	50%
Sérgio Magalhães	PhD Student	100%
Maria Isabel Fialho	PhD Student	100%
Norberto Catarino	PhD Student	100%
Morgana Streicher	PhD Student	100%
Bruno Nunes	PhD Student	30%
Jorge Rocha	Graduated Technician	100%
Filomena Baptista	Professional Technician	100%

OBJECTIVES

With the integration of ITN in Institute Superior Técnico (IST) the group decided to become member of Instituto de Plasmas e Fusão Nuclear (IPFN) of IST. This decision was supported by the long lasting collaboration with IPFN in Technical Programme of European Fusion Development Agreement (EFDA) initiated in 1998. This change didn't produce any significant modification with respect to the responsibilities and research orientation of the group. We kept the responsibility to run the ion beam laboratory developing and apply ion beam techniques to the study of advanced materials with high technological impact, especially in the fields of materials for fusion, wide band gap semiconductors and nanostructures for functional materials and cultural artefacts in collaboration with a long list of other groups. The main objectives were as summarised below.

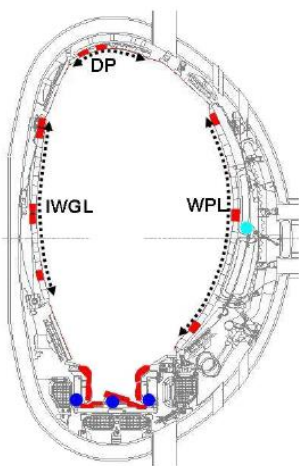
1. Operate the Ion Beam and X-ray Laboratories (IBL) guarantying the full operationality and constant upgrade of the equipment. Participation on the new Consortium to participate on the horizon2020 infrastructures programme.
2. Participation in the technology programme of the European Fusion Development Agreement using ion beam techniques to study plasma surface interaction processes as well as ^2H retention in JET tiles. Develop W-Ta based compounds and study their ^2H retention properties. Participation on the Fusion Consortium.
3. Research and development of ion beams based techniques to process and characterize wide band gap materials, II-VI and III-V semiconductors, superlattices and nanostructures.
4. Promote and make available to external users the ion beam techniques to study functional and nanomaterials, biomedical samples, archaeological and cultural heritage artefacts.

- Promote national and international collaborations and networks and apply for competitive funding programmes and projects.
- Training and Education continued as a major commitment of the group through the supervision of M.Sc. and Ph.D. thesis. The participation on Ciência Viva program is also supported.

MAIN ACHIEVEMENTS

Study of Plasma interaction with the main Wall and divertor in JET

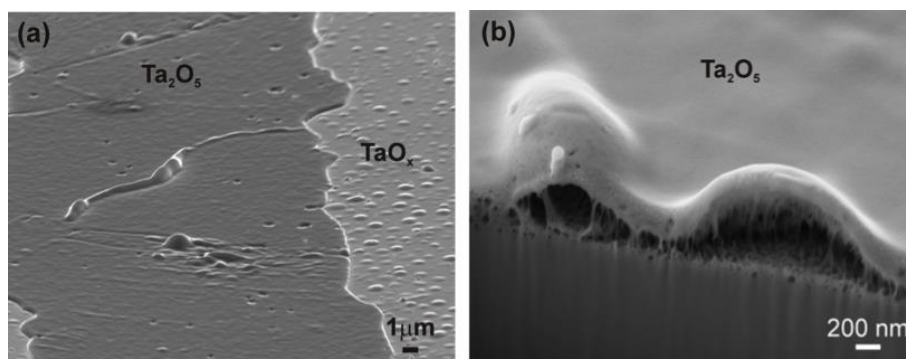
JET remains as the principal machine to study transport in the plasma and interaction of the plasma with the main wall and divertor in conditions close to ITER. Tiles and components from the new JET ITER-like Wall were now available and the first post-mortem analyses started. Erosion/deposition studies were performed to assess the extent of deposition and the associated D retention over surfaces interacting with the plasma and to give an overall pattern of the deposition. Several The tiles from the 2011-2012 experimental campaign were analysed under this activity task using ion beam techniques and are indicated in the figure below (red).



The results show that the mid-plane inner limiter is found to be a net erosion zone as a result of interaction with limiter plasmas. The erosion rate of Be from this region, 2.3×10^{19} atoms. s^{-1} , is higher than for JET-Carbon, 1.4×10^{19} atoms. s^{-1} . To fully understand these results further investigation into the factors which influence erosion rates, such as variation in incident flux, temperature, power, and contact point of the plasma, is required. Overall deposition in the divertor during the divertor plasma is reduced. The main area for deposition is at the top of the inner divertor where deposits of the order of 10 - 20 μm are observed. The deposition in the base divertor is two orders of the magnitude lower than for JET-Carbon and the migration of material to remote areas is also lower.

Development and Fuel Retention on High-Z materials for Wall applications

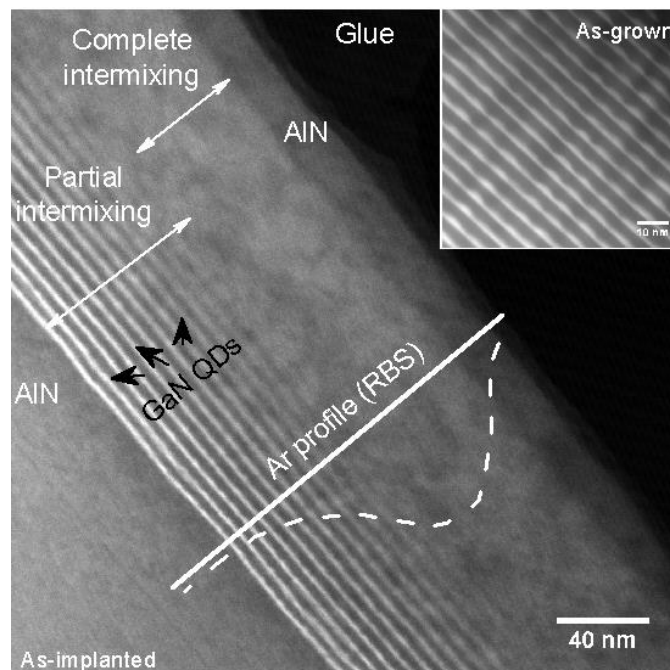
Dispersions of ductile Ta fibers in a W matrix have been proposed as a novel approach for the development of suitable plasma facing materials. We consolidate Tungsten-tantalum composites (W-Ta) by pulse plasma sintering (PPS) at 1500°C. Pure W and Ta plates as well as W-Ta composites were implanted with He^+ (pre implantation step) and D^+ ion beams at room temperature with fluences in the 10^{20} - 10^{21} at/m^2 range. The microstructure observations revealed that after consolidation the W/Ta interface reflects internal oxidation of Ta. Extensive (W,Ta) interdiffusion has not been observed and Ta_2O_5 and TaO interlayers have been identified at the W/Ta interface by EBSD. Results have also shown that W matrix remains unaltered after the implantations. However, blistering occurred in the Ta_2O_5 and in TaO_x regions Figure 1(a)) with single He^+ implantation and a more severe effect was observed after the sequential He^+ and D^+ implantation. The blister cavities evidence the formation of a nanometer-sized fiber structure (Figure 1(b)).



SE images showing microstructures observed in W-Ta implanted sequentially with He^+ and D^+ ions evidencing (a) blistering in Ta_2O_5 and TaO_x regions and (b) blister profile in Ta_2O_5 region.

Ion Beam Processing of Wide Band Gap materials

Two new projects funded by FCT started in 2013 with the objective of studying the effects of ion implantation in wide-band-gap semiconductor nanostructures. The project “Nanowires” aims at establishing the ion implantation technique for doping and defect engineering of GaN and oxide nanowires (NWs). GaN, Ga₂O₃ and Bi₂O₃ NWs have been successfully doped with rare earth ions exhibiting light emission in the visible and ultra violet spectral region. In the project “Greenlight”, ion beam enhanced quantum well (QW) intermixing is studied as a means to improve the internal quantum efficiency of group-III nitride LED structures. A detailed ion beam mixing study of GaN/AlN superlattices containing GaN QW or quantum dots (QD) revealed on the one hand the strong radiation resistance of GaN nanostructures and on the other hand an enhanced selective intermixing in 3D QD compared to QW.



TEM image of a GaN QD/AlN superlattice implanted with 100 keV Ar at 15 K to a fluence of 1×10^{16} at/cm². Regions of complete and partial intermixing as well as the Ar-profile measured by Rutherford Backscattering Spectrometry (RBS) are indicated.

Study of embedded ferromagnetic nitrides in large bandgap semiconductor oxides for electronics applications was also an important activity. Single crystals of MgO, Al₂O₃ and TiO₂ were co-implanted with ions of Fe (Co) and nitrogen at room temperature. The results show that *i*) magnetic Fe-nitrides do not form but α -Fe NPs form in both Al₂O₃ and TiO₂, while MgO displayed supermagnetic behaviour akin to the presence of magnetic NPs; *ii*) all samples co-implanted with Co display ferromagnetic behaviour which – since no Co aggregates were detected and Co₂N is paramagnetic – is assigned to Co₃N or Co₄N magnetic phases.

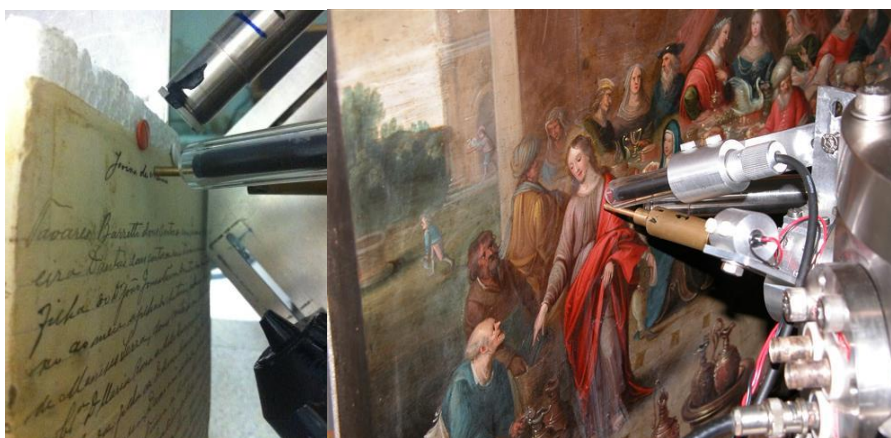
Ion beams on Cultural Heritage and Conservation

Several artefacts from private collections or National Museums, some of them classified as national Treasures or World Heritage, have been characterized using the microprobe end-station and the external proton beam. Late Bronze Age unique gold items from Museu Nacional de Arqueologia were analysed and soldered regions identified when considering the elemental distribution maps. Quantitative results indicate the use of intentional specific gold alloys with different melting points and an assembling mounting scheme could be proposed.

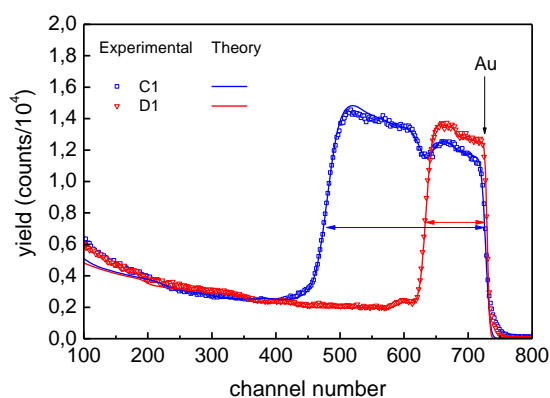
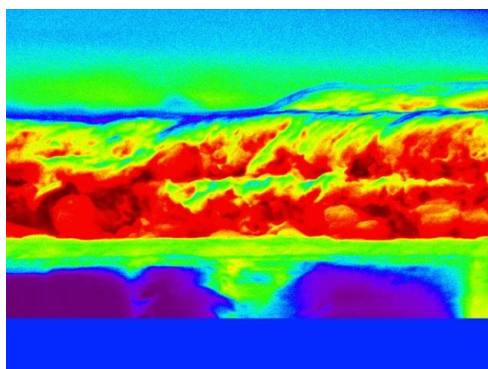
Hand-written documents with iron gall inks from the XIX century were also characterized. Initial studies were focused on finding the experimental conditions which preserve the documents. From

composition analyses it was possible to identify the presence of different inks even in the same document (figure below).

Studies were also done in the characterization of pigments on three XVII century oil paintings on copper plates by the Flemish artist Frans Francken. Results reveal the specific combination of elements used in the colour palette of the artist (figure below).



The adhesion, durability, consistency and reproducibility of decorative paintings with the noble metals Au, Ag and Pd in high added value Pb-glasses, in factory produced samples and laboratory prototypes, were analysed by IBA. The average thickness per layer, characteristic spread, contents in Au and Ag/Pd, and structure of the resulting decorative layer were extracted (figure) and shown to consist of nano-meter sized crystalline domains. The base Au paints were also analysed with the above mentioned techniques and also UV-Vis.-IR and DLS spectrometries, allowing definitely establishing their nature, in particular the absence of metallic NPs. The mechanisms behind the reduced release of Pb from the base glass after exposure to ammonium sulphate remain an open issue under investigation.



RELEVANT PAPERS

- M. Dias, R. Mateus, N. Catarino, N. Franco, D. Nunes, J.B. Correia, P.A. Carvalho, K. Hanada, C. Sârbu, E. Alves, Synergistic helium and deuterium blistering in tungsten–tantalum composites, *Journal of Nuclear Materials*, 442 (2013) 69–74, <http://dx.doi.org/10.1016/j.jnucmat.2013.08.010>.
- A. Hakola, S. Koivuranta, E. Ahonen, M.I. Airila, E. Alves, N. Barradas, J. P. Coad, A. Widdowson, D. Ivanova, M. Rubel, S. Brezinsek, and JET- EFDA Contributors, Local deposition of ¹³C tracer in the JET MKII-HD divertor, Jari Likonen, *Journal of Nuclear Materials*, 438 (2013) S762–S765, [doi.org/10.1016/j.jnucmat.2013.01.163](http://dx.doi.org/10.1016/j.jnucmat.2013.01.163).
- K. Lorenz, E. Nogales, S. M. C. Miranda, N. Franco, B. Méndez, E. Alves, G. Tourbot, B. Daudin, “Enhanced red emission from Praseodymium doped GaN nanowires by defect engineering”, *Acta*

Materialia 61 (2013) 3278–3284, <http://dx.doi.org/10.1016/j.actamat.2013.02.016>.

- A. Redondo-Cubero, K. Lorenz, E. Wendler, D. Carvalho, T. Ben, F.M. Morales, R. García, V. Fellmann, B. Daudin, “Selective ion-induced intermixing and damage in low-dimensional GaN/AlN quantum structures”, *Nanotechnology*, 24 (2013) 505717, doi:10.1088/0957-4484/24/50/505717.
- R. Viegas, V. Corregidor, M. T. Peña, E. Alves, L. C. Alves, Preliminary Studies on Iron Gall Inks Composition Using an External Ion Beam, *International Journal of Conservation Science*, 4, 593-602, 2013.

FUNDS

Project/Service	Responsible	Reference	Timeframe	2013
InN (4099)	Vanya Darakchieva	PTDC/FIS/100448/2008		31.985,82
NANOMOD (4100)	Katharina Lorenz	PTDC/CTM/100756/2008		27.860,49
MULTIFOX (4101)	Eduardo Alves	PTDC/FIS/105416/2008		774,22
Tomo3D (4103)	Rui Coelho Silva	PTDC/FIS/115089/2009		4.283,66
NAFEM (4105)	Eduardo Alves	PTDC/FIS/098943/2008		4.372,20
NanoMag (4107)	Rui Coelho Silva	PTDC/FIS/102270/2008		16.360,35
ACTION 3 (4188)	Eduardo Alves			10.565,52
NobleDec (4209)	Rui Coelho Silva	Nobly Decorated Crystal		CENTRAL
IST-ID Projects				
Grenoble (RD0254)	Katharina Lorenz	PROGRAMA PESSOA		2.000,00
GREENLIGHT (RD0256)	Katharina Lorenz	PTDC/FIS-NAN/0973/2012		26.724,75
NANOFIOS (RD0257)	Katharina Lorenz	PTDC/CTM-NAN/2156/2012		29.878,35
ViPena (RD0279)	Luis Alves	PTDC/EPH-PAT/3579/2012		7.740,00
AZ-MED (RD0280)	Rui Silva	PTDC/CPC-EAT/4719/2012		540,00

INTERNATIONALIZATION

- SPRITE-Supporting Postgraduate Research with Internships in industry and Training Excellence, FP7-PEOPLE-2012-ITN, *Grant agreement no.: 317169*.
- Autónoma University of Madrid, Spain Characterization of metal contacts on CdZnTe for detector applications.
- CAPES, Brasil, Al influence on the electrical and optical properties of GaInSb crystals grown by Czochralski method.
- Culham Center of Fusion Energy (CCFE), UK: Analysis of marker tiles from JET.
- University of Tennessee, USA, PhD project: Defects in sapphire implanted with Zr and O ions.
- Polish Academy of sciences, Institut of Physics, Poland: Ion beam studies of ZnMgO/ZnO bilayers grown by MBE.
- University of Jena, Germany: Ion beam modification of novel III-nitride hetero- and nano-structures.
- University of Bonn, Germany: PAC experiments in III-N compounds.
- University of Strathclyde, U.K.: Quantum well intermixing in InGaN/GaN quantum wells.
- CEA Grenoble, France: Rare Earth doping of GaN nanowires.
- University of Caen, France: Implantation damage formation in AlN.
- University of Cadiz, Spain: TEM analysis of implanted III-nitride superlattices.
- University Complutense of Madrid, Spain: Rare Earth doping of oxide nanowires and crystals.
- Institute of High Pressure Physics, Polish Academy of Sciences, Warsaw, Poland: High pressure high temperature annealing of III-nitrides.
- Humboldt University of Berlin, Germany: Growth of ZnCdO thin films.
- KAUST University, Saudi Arabia: Characterisation of InGaN thin films.
- National Institute for Materials Science, Tsukuba, Japan: Growth of Ga₂O₃ bulk crystals.

- Instituto de Ciencia de Materiales de Madrid (CSIC), Madrid, Spain: Nanopattern formation in semiconductor surfaces.
- Instituto de Sistemas Optoelectrónicos y Microtecnología, Polytechnic University of Madrid, Characterization of emerging oxide-based materials for UV photonics.

RESEARCHERS TEAM

NAME: Eduardo Jorge da Costa Alves

CATEGORY: Principal Researcher

IST-ID: 25357

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Administration Duties	30
2	Management of European Projects	30
3	Academic and Scientific Activities	15
4	Scientific Supervision	15
5	Management of FCT Projects	5
6	Scientific Collaborations (International)/Outreach	3
7	Coordination of Research Groups	2
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Vogal of the Installation Commission of IST/ITN, Polo de Loures. Director of “Laboratório de Aceleradores e Tecnologias de Radiação (LATR)”. Member of the Management Body of Instituto de Plasmas e Fusão Nuclear.
2	Elaboration of the participation of IPFN on the on Fusion Consortium on: JET PROJECTS WORK PROGRAMME 2014 & WORK PLAN 2014-2018 WorkPackage: WPJET2, plasma-facing components, IST/IPFN Technical Coordinator. ITER Physics WORK PROGRAMME 2014 & WORK PLAN 2014-2018 Work Package: WP14-IPH-PFC, Preparation of efficient PFC operation for ITER and DEMO, IST/IPFN Technical Coordinator. POWER PLANT PHYSICS & TECHNOLOGY PROJECTS WORK PROGRAMME 2014 & WORK PLAN 2014-2018 Work Package: Materials, IST/IPFN Technical Coordinator. Responsible officer for the IPFN activities under the EFDA JET Technology Workprogramme2013 (*) Local Coordination of FP7- Initial Training Network (ITN), SPRITE. (*)See projects
3	Member of the Scientific Council of IST. Habilitation. Seminars: In the scope of the Materials PhD programme of University of Aveiro and Master Thesis of IST and University of Aveiro seminars were presented. Reviewer: As a regular referee of Elsevier Journals and American Institute of Physics in the areas of Physics and Material Science several manuscripts were reviewed. In addition 8

	proposals for EMIR and CMAM were also assessed.
4	Supervisor of two post doc projects: Irradiation studies of tungsten based materials for fusion application (SFRH/BPD/68663/2010) and Study of Advanced Materials for Fusion Applications (project contract: F4E-2009-GRT-030-Action3) Supervisor of two PhD students: Production and irradiation studies of tungsten alloys based materials for fusion environment (SFRH/BD/88533/2012) and Study of the influence of Al content on optical activity and lattice site location of rare earth implanted $Al_xGa_{1-x}N$ (SFRH/BD/78740/2011). Co supervisor of a PhD thesis, Functionalization by ion implantation of Si: influence on tribomechanical and wettability properties at micro and nanoscales, (SFRH/BD/68513/2010).
5	Principal researcher of several FCT projects* running at the Ion Beam Laboratory (IBL). <ul style="list-style-type: none"> • High resolution depth profiling of light elements in multifunctional coatings and transparent conductive oxides (TCO). • Lattice site and implantation damage in nitrides implanted with rare-earths. • Interface roughness and mixing in GeSi/Al₂O₃ multilayers. • (*) See projects and publications indicator.
6	Scientific collaborations with the following Institutions were established: <ul style="list-style-type: none"> • University of Tennessee: Co-implantation of Zr and O in sapphire (Al₂O₃) to study defect formation (PhD project). • Universidad Autónoma de Madrid: Development of double layer contacts for CdZnTe semiconductors. • University of Seville, Study of semiconducting multilayers. • University of Sfax, Rare earth doping of ZnO films. • KIT, Karlsruhe, Study of 2H retention in Be. • Outreach: As radiações e os Materiais - Interações proveitosas. <i>País Positivo</i>, Sol, 21 de Dezembro de 2012.
7	<ul style="list-style-type: none"> • Coordination and management of the Ion Beam and Nuclear Techniques of Centro de Física Nuclear (CFNUL) assuring the integration of the activities at the IBL and RPI on the center policy. • Coordination of the Materials for Fusion Group of IPFN supervising the activities under the European Consortium.

PUBLICATIONS

1. **Effects of helium and deuterium irradiation on SPS sintered W-Ta composites at different temperatures**, R. Mateus, M. Dias, J. Lopes, J. Rocha, N. Catarino, N. Franco, V. Livramento, P.A. Carvalho, J.B. Correia, K. Hanada, E. Alves, *Journal of Nuclear Materials* 442 (2013) S251–S255, <http://dx.doi.org/10.1016/j.jnucmat.2013.02.068>
2. **Studies on deuterium retention in W-Ta based materials**, M Dias, R Mateus, N Catarino, V Livramento, J B Correia, P A Carvalho, K Hanada, N Pinhão, P Barquinha, E Alves, *Microscopy and Microanalysis*, 01/2013; 19(Supplement S4):125-126. DOI:10.1017/S1431927613001244
3. **Blistering of W – Ta composites at different irradiation energies**, R. Mateus, M. Dias, J. Lopes, J. Rocha, N. Catarino, P. Duarte, R.B. Gomes, C. Silva, H. Fernandes, V. Livramento, P.A. Carvalho, E. Alves, K. Hanada, J.B. Correia, *Journal of Nuclear Materials* 438 (2013) S1032–S1035, <http://dx.doi.org/10.1016/j.jnucmat.2013.01.225>
4. **Composition and luminescence studies of InGaN epilayers grown at different hydrogen flow rates**, E Taylor, F Fang, F Oehler, P R Edwards, M J Kappers, K Lorenz, E Alves, C McAleese, C J Humphreys, RWMartin, *Semicond. Sci. Technol.* 28 (2013) 065011, doi:10.1088/0268-1242/28/6/065011
5. **Development of tantalum oxynitride thin films produced by PVD: Study of structural stability**, D. Cristea, A. Crisan, N.P. Barradas, E. Alves, C. Moura, F. Vaz, L. Cunha, *Applied Surface Science* 285P (2013) 19– 26, <http://dx.doi.org/10.1016/j.apsusc.2013.06.061>
6. **Electrical and Photocatalytic Behaviour of TaO_(x)N_(y) Magnetron Sputtered Thin Solid Films**, D. Cristea, A Crisan, NP Barradas, E Alves, P Costa, S Lanceros-Mendez, L Cunha, *Metalurgia International* 2013 ISSN: 1582-2214 (2013)

7. **Extended-Gate ISFETs Based on Sputtered Amorphous Oxides**, J.V. Pinto, R. Branquinho, P. Barquinha, E. Alves, R. Martins, E. Fortunato, *Journal of Display Technology*, (Volume:9, Issue:9) doi: [10.1109/JDT.2012.2227298](https://doi.org/10.1109/JDT.2012.2227298)
8. **Influence of RF-sputtering power on formation of vertically stacked Si_{1-x}Gex nanocrystals between ultra-thin amorphous Al₂O₃ layers: structural and photoluminescence properties**, E M F Vieira, J Mart´in-S´anchez, M A Roldan, M Varela, M Buljan, S Bernstorff, N P Barradas, N Franco, M R Correia, A G Rolo, S J Pennycook, S I Molina, E Alves, A Chahboun, M J M Gomes, *J. Phys. D: Appl. Phys.* 46 (2013) 385301 (10pp), doi:10.1088/0022-3727/46/38/385301
9. **Influence of thermal annealing on structural and optical properties of Au:TiO₂ nanocomposite film**, A Marin, D Munteanu, E Alves, NP Barradas, L Cunha, C Moura, *Journal of Optoelectronics and Advanced Materials*, Volume: 15, Issue: 5-6, Pages: 539-543, Published: MAY-JUN 2013
10. **Measurement and evaluation of the ¹³C(p,p)¹³C cross section in the energy range 0.8–2.4 MeV**, N.P. Barradas, N. Catarino, E. Alves, I. Bogdanovic´ Radovic´, A.F. Gurbich, *Nuclear Instruments and Methods in Physics Research B* 316 (2013) 81–87, <http://dx.doi.org/10.1016/j.nimb.2013.08.041>
11. **Microstructure and nanomechanical properties of Fe⁺ implanted Silicon**, B. Nunes, S. Magalhaes, N. Franco, E. Alves, R. Colaço, *Applied Surface Science* 284 (2013) 533– 539, <http://dx.doi.org/10.1016/j.apsusc.2013.07.129>
12. **Nanocomposite Ag:TiN thin films for dry biopotential electrodes**, P. Pedrosa, D. Machado, C. Lopes, E. Alves, N.P. Barradas, N. Martin, F. Macedo, C. Fonseca, F. Vaz, *Applied Surface Science* 285P (2013) 40– 48, <http://dx.doi.org/10.1016/j.apsusc.2013.07.154>
13. **Nanostructures and thin films of transparent conductive oxides studied by perturbed angular correlations**, M. B. Barbosa, J. N. Gonçalves, A. Redondo-Cubero, S. M. C. Miranda, R. Simon, P. Kessler, M. Brandt, F. Henneberger, E. Nogales, B. Méndez, K. Johnston, E. Alves, R. Vianden, J. P. Araújo, K. Lorenz, J. G. Correia, *Phys. Status Solidi B* 250, No. 4, 801–808 (2013) / DOI 10.1002/pssb.201200923
14. **On the formation of an interface amorphous layer in nanostructured ferroelectric Ba_{0.8}Sr_{0.2}TiO₃ thin films integrated on Pt–Si and its effect on the electrical properties**, J.P.B. Silva, K.C. Sekhar, S.A.S. Rodrigues, M. Pereira, A. Parisini, E. Alves, N.P. Barradas, M.J.M. Gomesa *Applied Surface Science* 278 (2013) 136–141, <http://dx.doi.org/10.1016/j.apsusc.2012.11.161>
15. **p-Type Cu_xO Thin-Film Transistors Produced by Thermal Oxidation**, V. Figueiredo, J. V. Pinto, J. Deuermeier, R. Barros, E. Alves, R. Martins, E. Fortunato, *Journal of Display Technology*, Vol. 9, Issue 9, pp. 735-740 (2013), <http://www.opticsinfobase.org/jdt/abstract.cfm?URI=jdt-9-9-735>
16. **Spectroscopy of radiation defects in rutile TiO₂**, C. M. M. Rosário, M. P. F. Graça, M. A. Valente, L. C. Costa, J. Rodrigues, T. Monteiro, E. Alves, N. A. Sobolev, *Phys. Status Solidi B* 250, No. 4, 843–849 (2013) / DOI 10.1002/pssb.201200917
17. **Synergistic helium and deuterium blistering in tungsten–tantalum composites**, M. Dias a,†, R. Mateus, N. Catarino, N. Franco, D. Nunes, J.B. Correia, P.A. Carvalho, K. Hanada, C. Sârbu, E. Alves, *Journal of Nuclear Materials* 442 (2013) 69–74, <http://dx.doi.org/10.1016/j.jnucmat.2013.08.010>
18. **Status of the MARE Experiment**, M.R.Gomes, F Gatti, A Nucciotti, P Manfrinetti, M Galeazzi, E Alves, D Bagliani, NP Barradas, S Basak, M Biasotti, E Ferri, A Kling, G Pizzigoni, K Prasai, J Rocha, *Ieee Transactions on Applied Superconductivity*, vol. 23, 2013, Doi:10.1109/tasc.2013.2249180
19. **TiAg_x thin films for lower limb prosthesis pressure sensors: Effect of composition and structural changes on the electrical and thermal response of the films**, C. Lopes, C. Gonc, alves, P. Pedrosa, F. Macedo, E. Alves, N.P. Barradas, N. Martin, C. Fonseca, F. Vaz, *Applied Surface Science* 285P (2013) 10– 18, <http://dx.doi.org/10.1016/j.apsusc.2013.07.021>
20. **Towards the understanding of the intentionally induced yellow luminescence in GaN nanowires**, J. Rodrigues, S. M. C. Miranda, A. J. S. Fernandes, E. Nogales, L. C. Alves, E. Alves, G. Tourbot, T. Auzelle, B. Daudin, B. Méndez, T. Trindade, K. Lorenz, F. M. Costa, T. Monteiro, *P hys. Status Solidi C* 10, No. 4, 667–672 (2013) / DOI 10.1002/pssc.201200714

21. **Formation and delamination of beryllium carbide films**, R. Mateus, P.A. Carvalho, N. Franco, L.C. Alves, M. Fonseca, C. Porosnicu, C.P. Lungu, E. Alves, *Journal of Nuclear Materials*, doi.org/10.1016/j.jnucmat.2013.04.009
22. **The influence of photon excitation and proton irradiation on the luminescence properties of yttria stabilized zirconia doped with praseodymium ions**, M.R.N. Soares, M.J. Soares, L.C. Alves, E. Alves, K. Lorenz, F.M. Costa, T. Monteiro, *Nuclear Instruments and Methods in Physics Research B* 306 (2013) 207–211, <http://dx.doi.org/10.1016/j.nimb.2012.11.036>
23. **The defect structure of sapphire produced by implantation of Zr and Zr plus O: threshold fluence for amorphization and optical properties**, Younes Sina, Peter D. Townsend, Carl J. McHargue, Eduardo Jorge da Costa Alves, *Phys. Status Solidi C* 10, No. 2, 202–207 (2013) / DOI 10.1002/pssc.201200392
24. **Saturation of hydrogen retention in gallium samples exposed to tokamak ISTTOK plasmas**, R.B. Gomes, R. Mateus, E. Alves, M.F. Montemor, C. Silva, H. Fernandes, P. Duarte, *Journal of Nuclear Materials* 438, 2013, S992-S995, doi.org/10.1016/j.jnucmat.2013.01.216
25. **Properties of tantalum oxynitride thin films produced by magnetron sputtering: The influence of processing parameters**, D. Cristea, D. Constantin, A. Crisan, C.S. Abreu, J.R. Gomes, N.P. Barradas, E. Alves, C. Moura, F. Vaz, L. Cunha, *Vacuum* 98 (2013) 63e69, <http://dx.doi.org/10.1016/j.vacuum.2013.03.017>
26. **Microprobe analysis, iono- and photo-luminescence of Mn²⁺ activated ZnGa₂O₄ fibres**, N.F. Santos, A.J.S. Fernandes, L.C. Alves, N.A. Sobolev, E. Alves, K. Lorenz, F.M. Costa, T. Monteiro, *Nuclear Instruments and Methods in Physics Research B* 306 (2013) 195–200, <http://dx.doi.org/10.1016/j.nimb.2012.12.029>
27. **Local deposition of ¹³C tracer in the JET MKII-HD divertor**, Jari Likonen, A. Hakola, S. Koivuranta, E. Ahonen, M.I. Airila, E. Alves, N. Barradas, J. P. Coad, A. Widdowson, D. Ivanova, M. Rubel, S. Brezinsek, and JET- EFDA Contributors, *Journal of Nuclear Materials* 438 (2013) S762–S765, doi.org/10.1016/j.jnucmat.2013.01.163
28. **Lattice site location and luminescence studies of Al_xGa_{1-x}N alloys doped with thulium ions**, M. Fialho, K. Lorenz, S. Magalhães, J. Rodrigues, N.F. Santos, T. Monteiro, E. Alves, *Nuclear Instruments and Methods in Physics Research B* 307 (2013) 495–498, <http://dx.doi.org/10.1016/j.nimb.2013.01.010>
29. **Influence of stoichiometry and structure on the optical properties of Al_NO_y films**, J Borges, N P Barradas, E Alves, M F Beaufort, D Eyidi, F Vaz, L Marques, *J. Phys. D: Appl. Phys.* 46 (2013) 015305 (11pp), doi:10.1088/0022-3727/46/1/015305
30. **Influence of composition, bonding characteristics and microstructure on the electrochemical and optical stability of AlO_xNy thin films**, J. Borges, C. Fonseca, N.P. Barradas, E. Alves, T. Girardeau, F. Paumier, F. Vaza, L. Marques, *Electrochimica Acta* 106 (2013) 23– 34, <http://dx.doi.org/10.1016/j.electacta.2013.05.020>
31. **Formation of oriented nickel aggregates in retile single crystals by Ni implantation**, M.M. Cruz, R.C.daSilva, J.V.Pinto, R.P.Borges, N.Franco, A.Casaca, E. Alves, M.Godinho, *Journal of Magnetism and Magnetic Materials* 340(2013)102–108, doi.org/10.1016/j.jmmm.2013.03.032
32. **Enhanced red emission from praseodymium-doped GaN nanowires by defect engineering**, K. Lorenz, E. Nogales, S.M.C. Miranda, N. Franco, B. Méndez, E. Alves, G. Tourbot, B. Daudin, *Acta Materialia* 61 (2013) 3278–3284, doi.org/10.1016/j.actamat.2013.02.016
33. **Comparison of low- and room-temperature damage formation in Ar ion implanted GaN and ZnO**, E. Wendler, W. Wesch, A.Yu. Azarov, N. Catarino, A. Redondo-Cubero, E. Alves, K. Lorenz, *Nuclear Instruments and Methods in Physics Research B* 307 (2013) 394–398. <http://dx.doi.org/10.1016/j.nimb.2013.01.020>
34. **CdTe nano-structures for photovoltaic devices**, V. Corregidor, L.C. Alves, N. Franco, M.A. Barreiros, N.V. Sochinskii, E. Alves, *Nuclear Instruments and Methods in Physics Research B* 306 (2013) 218–221, <http://dx.doi.org/10.1016/j.nimb.2012.11.051>
35. **A comparative study of photo-, cathodo- and ionoluminescence of GaN, nanowires implanted with rare earth ions**, J. Rodrigues, S.M.C. Miranda, M. Peres, E. Nogales, L.C. Alves, E. Alves, G. Tourbot, B. Daudin, B. Méndez, K. Lorenz, T. Monteiro, *Nuclear Instruments and Methods in Physics Research B* 306 (2013) 201–206, <http://dx.doi.org/10.1016/j.nimb.2012.12.028>

COMMUNICATIONS

Talks

- *Oxidation of neutron irradiated Be pebbles*, 11th IEA International workshop on Beryllium Technology for Fusion, Barcelona, 11-14 September.
- *Terbium implanted Al_xGa_{1-x}N alloys: Damage and optical effects*, 17th International Conference on Radiation Effects on Insulators, Helsinki, 1-5 July.

Seminars

- *Ion beam techniques for materials studies*, IST / CTN, December 3, 2013
- *Rutherford backscattering and ion channeling*, Doctoral Program in Materials Science and Engineering, Advanced techniques for characterization of materials, University of Aveiro, October 25, 2013.
- *Ion Beams a window for the knowledge*, Colloquium Departamento de Física IST, IST, October 09, 2013.
- *Radiations in our daily life: from the origin to the applications*, Aplicações das Radiações Ionizantes à Industria Farmacêutica Hovione, June 21, Sala de Conferências / Fábrica de Loures.
- *Applications of ionizing radiation to industry: Infrastructures, Methods and Applications*, Workshop Applications of ionizing radiation to industry, Campus Tecnológico e Nuclear, April 22, 2013

Posters

- *The role of Sn on the crystalline quality of epitaxial GeSn/Si films*, N. Catarino, N. Franco, N. P.Barradas, M.F. Cerqueira, F. Oliveir⁵, Jens Werner, Jörg Schulze, Michael Oehme, E. Alves, 21nd International conference on Ion Beam Analysis, Seattle, 23-28 Junho, EUA 2013.

EDUCATION

Theses Supervision

- Supervisor: Marta Dias, Irradiation studies of tungsten based materials for fusion application, ITN, SFRH/BPD/68663/2010.
- Supervisor: Norberto Catarino, Production and irradiation studies of tungsten alloys based materials for fusion environment, IST, SFRH/BD/88533/2012.
- Supervisor: Maria Isabel Guerreiro Fialho, Study of the influence of Al content on optical activity and lattice site location of rare earth implanted Al_xGa_{1-x}N, IST, SFRH/BD/78740/2011. Co-Supervisor: Bruno Miguel Fernandes Nunes, Functionalization by ion implantation of Si: influence on tribomechanical and wettability properties at micro and nanoscales, IST, SFRH/BD/68513/2010.
- Co-Supervisor: Bruno Miguel Fernandes Nunes, Functionalization by ion implantation of Si: influence on tribomechanical and wettability properties at micro and nanoscales, IST, SFRH/BD/68513/2010.

Jury Membership

- Member of the Jury of the PhD thesis by Hélio Fernandes Luís, "Study of nuclear reactions relevant for astrophysics by micro-AMS", Universidade Nova de Lisboa, December 13, 2013.
- Member of the Jury of the PhD thesis by Sérgio Nuno Magalhães Construction Site, "Characterization and modification of the Group III - Nitride Heterostructures", University of Aveiro, March 20, 2013.
- External Examiner of PhD Thesis of Mallikarjuna Motapothula, "Ion Channeling in Ultra Thin Crystals", University of Singapore, April 3, 2013.

PROJECTS

- **SPRITE-Supporting Postgraduate Research with Internships in industry and Training Excellence**, FP7-PEOPLE-2012-ITN, *Grant agreement no.: 317169*, IST Coordinator.

- **Validation of modelling of material transport, erosion deposition and tritium retention in plasma facing materials using post-mortem analysis**, *EFDA JET Technology Workprogramme2013, JW13-FT- 5.49*, IST/IPFN Responsible Officer.
- **Plasma cleaning of Mirrors**, *EFDA JET Technology Workprogramme2013, JW13-FT- 3.79*, IST/IPFN Responsible Officer.
- **Analyses of mixed materials on ILW samples using XPS/AES, XRD and RBS**, *EFDA JET Technology Workprogramme2013, JW13-FT-3.80*, IST/IPFN Responsible Officer.
- **Analysis of mirrors exposed in JET-ILW and procurement of mirrors for exposure in JET 2014 campaigns: First mirror test for ITER**, *EFDA JET Technology Workprogramme2013, JW13-FT-3.78*, IST/IPFN Responsible Officer.
- **Material transport and erosion/deposition in the JET torus**, *EFDA JET Technology Workprogramme2013, JW13-FT-3.82*, IST/IPFN Responsible Officer.
- **Neutrino mass direct determination: Portuguese contribution to MARE**, PTDC/FIS/116719/2010, Prime Contractor: U. Lisboa (M.José), IST Coordinator.
- **Nanocristais Ferromagnéticos de ZnO dopado para dispositivos de resistência de tunelamento magnético (TMR)**, PTDC/FIS/098943/2008, Prime Contractor: U. Minho (M.Jesus), IST Coordinator.
- **MULTIFOX: Modificação e estudo à escala nanométrica de óxidos multiferróicos**, PTDC/FIS/105416/2008, Prime Contractor: U. Aveiro (V. Amaral), IST Coordinator.
- **Laboratory of Accelerators and Radiation Technologies**, *Candidatura: ROTEIRO/0038/2013*.

CONFERENCE ORGANISATION

- Local Organizer of 12th annual meeting of the EU-PWI task force 27-29 November 2013, IST, Lisbon, Portugal.
- Local Organizer of Task Force Fusion Technology Ion Beam Analysis Review and Planning Meeting, 19-20 November 2013, IST, Bobadela, Portugal.
- International committee of International Conference Series on Ion Beam Analysis, IBA.
- International committee of International Conference Series on Ion Beam Modification of Materials, IBMM.
- International committee of International Conference Series on Radiation Effects in Insulators, REI.
- Scientific Committee of Réseau National d'accélérateurs pour les Etudes des Matériaux sous Irradiation-EMIR.
- Scientific Committee of Centro de Microanálisis de Materiales, Universidad Autónoma de Madrid- CMAM, Spain (www.cmam-btmanager).

COLLABORATIONS

- 10-15/02 and 23-27/09/2013: Joseph Paul Coad, English, EURATOM/UKAEA FUSION ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET.
- 10-15/02 and 02-06/12/2013: Aleksandra Baron-Wiechec, Swedish, EURATOM/UKAEA FUSION ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET.
- 10-15/02/2013: Marek Rubel, Swedish, KTH/ROYAL INSTITUTE OF TECHNOLOGY, Study of Plasma exposed tiles and chamber components at JET.
- 10-15/02/2013: Per Petersson, Swedish, SWEDISH VR ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET.
- 17-22/03 and 03-07/06/2013: Anna Marie Widdowson, English, EURATOM/UKAEA FUSION ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET.
- 17-24/03/2013: Darya Ivanova, Swedish, SWEDISH VR ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET.
- 05-22/04/2013: Ines Ortega Felio, Spanish, CNA/CENTRO NACIONAL DE ACELERADORES, Ion beam studies of multilayers.
- 03-07/06/2013: Kalle Heinola, Finnish, EURATOM/ UKAEA FUSION ASSOCIATION, Study of Plasma exposed tiles and chamber components at JET
- 16-20/12/2013: Ramzi Maalej, Tunisian, ACORDO BILATERAL PORT./TUNÍSIA, Study of ZnO films doped with rare-earths.

NAME: Rui Manuel Coelho da Silva

CATEGORY: Principal Researcher

IST-ID: 5383

N°	Activity Description	R&D (%)
1	PTDC/FIS /102270/2008 Nanostructured magnetic nitrides	20
2	PTDC/CTM-MET/112831/2009 Fault-tolerant anticorrosion coatings for magnesium alloys	05
3	PTDC/FIS /115089/2009 Depth-selective Ion Microprobe Tomography-Tomo3D	30
4	QREN/COMPETE AdI/23274/2012 Nobly Decorated Crystal-NobleDec	25
5	Medieval Portuguese tiles: materials, production techniques and provenance study (co-supervision of SFRH/BD/73007/2010)	10
6	Data acquisition and interface control	10
Total		100

WORK SUMMARY

N°	Work Summary and Main Achievements
1	<p>Aiming at studying embedded ferromagnetic nitrides in large bandgap semiconductor oxides for electronics applications, single crystals of MgO, Al₂O₃ and TiO₂ were co-implanted with ions of Fe (Co) and nitrogen at room temperature. After implanting atomic nitrogen with fluences of $5 \times 10^{16} \text{ cm}^{-2}$ and 35 keV energy the TM ions Fe (Co) were implanted with fluences of $2 \times 10^{17} \text{ cm}^{-2}$ and 120 keV energy, in order to get overlap of implanted profiles. The fluence ratio N/TM ~ 4 was chosen to better potentiate formation of TM nitride phases. The implanted TM profiles were analysed by RBS, structure and composition modifications followed by RBS and RBS/C, and the nitrogen depth profiles assessed using the $^{14}\text{N}(p,p)^{14}\text{N}$ elastic reaction. The search for nitride phases was performed by XRD (and CEMS in the case of Fe), and the magnetic properties investigated by SQUID magnetometry.</p> <p>The results show that <i>i</i>) magnetic Fe-nitrides do not form but α-Fe NPs form in both Al₂O₃ and TiO₂, while MgO displayed supermagnetic behaviour akin to the presence of magnetic NPs; <i>ii</i>) all samples co-implanted with Co display ferromagnetic behaviour which – since no Co aggregates were detected and Co₂N is paramagnetic – is assigned to Co₃N or Co₄N magnetic phases.</p>
2	<p>Aiming at contributing to the development of fault-tolerant anticorrosion coatings for magnesium alloys, samples of ZE41 aeronautic grade were reanalysed with ^4He ions and proton beams with energies of 2 MeV by RBS. Anodized and PEO polymer coated samples were analysed after long term storage and compared with prior analysis in order to ascertain long term stability. No significant compositional changes were found, indicating a good chemical static stability – <i>i.e.</i> under current in-house atmospheric exposure and in the absence of mechanical aggression. – These results were communicated to research partner IST.</p>
3	<p>Continuing the development of PIXE and STIM-T based micro-tomography from map sets generated with the LATR ion microprobe the following tasks were completed:</p> <ul style="list-style-type: none">• generation of STIM-T map sets from micro-samples with up (35-50) μm thickness (depending on the composition) for demonstration of capacity of routine analysis and reproducibility;• functional characterization and demonstration of the gas flow ionization chamber prototype detector developed at LIP in routine use with on-axis STIM-T. Elaboration of specifications for a new detector of the same type allowing variable distance to target;• improvement of the 5+2 degrees of freedom precision positioning stage, development of a support platform for alignment of samples with the rotation axis with micrometer precision, allowing nearly precession-free rotation;• development of JPIXET software for pre-processing and reconstruction of STIM-T and

	<p>PIXE-T data, with CUDA-implementation for GPU acceleration;</p> <ul style="list-style-type: none"> • first installation and test of X-ray micro-lenses for confocal PIXE based micro-tomography.
4	<p>Aiming at contributing to solve the problems of adhesion, durability, consistency and reproducibility of decorative paintings with the noble metals Au, Ag and Pd in high added value Pb-glasses, factory produced samples with decorative films in different stages of processing, and laboratory prototypes produced with different techniques (micro-wave and laser assisted metallisation) and formulations, were analysed by PIXE, RBS, XRD and SEM. Substrate Pb-glass samples in both the raw state and after attack by ammonium sulphate vapours (used for reduction of Pb release) were also analysed.</p> <p>The average thickness per layer, characteristic spread and contents in Au and Ag/Pd are consistent with the application information provided by the manufacturers of the Au paints. The structure of the resulting decorative layer was shown to consist of nano-meter sized crystalline domains.</p> <p>The base Au paints were also analysed with the above mentioned techniques and also UV-Vis.-IR and DLS spectrometries, allowing definitely establishing their nature, in particular the absence of metallic NPs.</p> <p>The mechanisms behind the reduced release of Pb from the base glass after exposure to ammonium sulphate remain an open issue.</p>
5	<p>Aiming at contributing to solve the question of whether there was local production of decorative tiles in Portugal, in the historic period from late XIVc. to early XVc., samples from a collection of Hispano-Moresque tiles unearthed during archaeological excavations of the Monastery of Santa Clara-a-Velha, were analysed by micro-PIXE and RBS. The results were cross-compared with results obtained by XRF, SEM-EDS and Raman spectroscopy.</p> <p>Homogeneous glazes with lead contents (37-54) wt.% were found suggesting usage of glass frit. Glaze homogeneity, together with high tin contents (ca. 7–14 wt.%) and small and well dispersed tin oxide crystals in the white and blue glazes indicates closeness to the Islamic technology. On the other hand, Ca-rich thick glaze–ceramic interfaces with mineral inclusions as wollastonite and K-feldspars resemble more the later Hispano-Moresque technology, employing single-firing processes at temperatures between 950 °C and 1000 °C, and a common recipe for glazing of <i>cuerva-seca</i> and <i>arista</i> tiles, the dominant types of the collection.</p> <p>This study provides the first analytical indicator of a production technology with differences from the Hispano-Moresque workshops of Seville, Toledo, etc., indicating a possible local production.</p>
6	<p>Computer codes for use in IBA experimental control and automatic data acquisition, and for spectral data conversion continued being improved and expanded in specific capacities, namely:</p> <ul style="list-style-type: none"> • GonMTRS32 code used for automatic experiments and data acquisition by RBS, NRA and PIXE, extended with control of the setup dedicated to fusion aimed JET materials characterization by IBA, was endowed with <i>i</i>) possibility of in-situ re-parametrization of ADCs; <i>ii</i>) extended number of ROIs; <i>iii</i>) automatic recording of magnetic field for energy analysis. • CvDataX code for spectral data format conversion was enhanced by allowing for new input and output formats (added formats), including back-conversion to AIEA and Gupix tagged ASCII formats. • new control of stepping motors control drive and power units, aiming at <i>i</i>) duplicating the IBA experimental control setup GUIs in use with the VG accelerator, for use with the tandem accelerator; <i>ii</i>) controlling the attitude of the precision positioning stage of the micro-tomography setup in the ion microprobe. <p>The new release of the user interface Genie2k (CANBERRA©) for MCA boards control and data acquisition was successfully tested in network operation, driving remote MCA boards.</p>

PUBLICATIONS

- S. Routa, N. Popovicia, S. Daluia, M.L. Paramês, R.C. da Silva, A.J. Silvestre, O. Conde, Phase growth control in low temperature PLD Co:TiO₂ films by pressure, *Current Applied Physics*, 13(2013) 670-676. DOI: [10.1016/j.cap.2012.11.005](https://doi.org/10.1016/j.cap.2012.11.005).
- A.C. Marques, M.M.F.R. Fraga, P. Fonte, D.G. Beasley, L.C. Alves, R.C. da Silva, New gas detector setup for on-axis STIM tomography experiments, *Nuclear Instruments and Methods*, B, 306 (2013) 104-8. DOI: [10.1016/j.nimb.2012.12.038](https://doi.org/10.1016/j.nimb.2012.12.038).
- M.M. Cruz, R.C. da Silva, J.V. Pinto, R.P. Borges, N. Franco, A. Casaca, E. Alves, M. Godinho, Formation of oriented nickel aggregates in rutile single crystals by Ni implantation, *Journal of Magnetism and Magnetic Materials*, 340 (2013) 102-8. DOI: [10.1016/j.jmmm.2013.03.032](https://doi.org/10.1016/j.jmmm.2013.03.032).
- D.G. Beasley, A.C. Marques, L.C. Alves, R.C. da Silva, Fast simulation of Proton Induced X-Ray Emission tomography using CUDA, *Nuclear Instruments and Methods*, B 306 (2013) 109-12. DOI: [10.1016/j.nimb.2012.12.053](https://doi.org/10.1016/j.nimb.2012.12.053).
- M.G. Ventura, D. Krasilnikova, T. Silva, R.C. da Silva, A.J. Parola, A.P. Matos, Colouring glasses using nanoparticles synthesized within polyelectrolyte layer by layer films, *Journal of Non-Crystalline Solids*, 379 (2013) 80-88. DOI: [10.1016/j.jnoncrysol.2013.07.030](https://doi.org/10.1016/j.jnoncrysol.2013.07.030).
- R.P. Borges, B. Ribeiro, A.R.G. Costa, C. Silva, R.C. da Silva, G. Evans, A.P. Gonçalves, M.M. Cruz, M. Godinho, U. Wahl, Nanoparticles of Ni in ZnO single crystal matrix, *European Physics Journal B*, 86 (2013) 254-60. DOI: [10.1140/epjb/e2013-40008-5](https://doi.org/10.1140/epjb/e2013-40008-5).

COMMUNICATIONS

- *Defects produced in IBIL analysis of sapphire*, C. Marques, M. Fialho, L.C. Alves, R.C. da Silva, E. Alves, E-MRS 2013 Spring Meeting, Strasbourg, France, 27-31 May. 2013. [Poster](#).
- *Simulation of the optical spectra of noble metal nano-particles with effective medium theory*, C. Marques, L.C. Alves, R.C. da Silva, E. Alves, REI-17, Univ. Helsinki, Helsinki, Finland, 30 Jun.-05 Jul. 2013. [Poster](#).
- *Magnetic nitride nanoparticles produced by ion implantation*, C. Silva, R.C. da Silva, L.P. Ferreira, M.D. Carvalho, M. Godinho, M.M. Cruz, JEMS 2013 – Joint European Magnetic Symposia, Rhodes, Greece, 25-30 Aug. 2013. [Poster](#).
- *Substrate influence on the structure and magnetic properties of M-N (M=Fe,Co) thin films*, C. Silva, A. Vovk, R.C. da Silva, P. Štrichovanec, P.A. Algarabel, A.P. Gonçalves, L.P. Ferreira, M.D. Carvalho, M. Godinho, M.M. Cruz, JEMS 2013 – Joint European Magnetic Symposia, Rhodes, Greece, 25-30 Aug. 2013. [Poster](#).
- *A comparison of quantitative reconstruction techniques for PIXE-Tomography analysis applied to biological samples*, D.G. Beasley, L.C. Alves, Ph. Barberet, S. Bourret, G. Deves, N. Gordillo, C. Habchi, Q. Letrequesser, A.C. Marques, H. Sez nec, R.C. da Silva, ECAART-11, *The 11th European Conference on Accelerators in Applied Research and Technology*, Namur, Belgium, 08-13 Sep. 2013. [Palestra](#) por D. Beasley (13 Sep. 2013).

EDUCATION / THESES SUPERVISION

- Co-supervisor of (2nd trienium) post-doctoral work of D.Sc. Ana Cláudia Santana Marques, *3D Microprobe: Tomography by PIXE, RBS and STIM* (SFRH/BPD/65817/2009).
- Co-supervisor of D.Sc. work of M.Sc. Susana Xavier Coentro, *Medieval Portuguese tiles: materials, production techniques and provenance study* (SFRH/BD/73007/2010).
- Invited Professor, *Nuclear Physics*. Theoretical lectures and laboratory practice on nuclear physics at introductory level: one semester course for the 7th semester of the Physical Engineering and Biomedical Engineering curricular plans, Faculty of Sciences and Technology, Universidade Nova de Lisboa.
- Welcome and introductory talks about the mission and the on-going technical and scientific work at IST/ITN, for regular scheduled visitors students from high schools and universities (responsibility shared with colleague research officers António Falcão and Nuno Barradas).

- Arguing member of the doctoral thesis in Physics of M.Sc. Hélio Fernandes Luís, *Study of nuclear reactions relevant for astrophysics by micro-AMS*, Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, 13 de Dezembro de 2013.

PROJECTS

- *Nanostructured magnetic nitrides-Nanomag*. Grant PTDC/FIS /102270/2008. Leading Institution: FFCUL. IST/CTN Coordinator: R.C. Silva (20%). IST budget (overall): 41875 €.
- *Fault-tolerant anticorrosion coatings for magnesium alloys-Fatomag*. Grant PTDC/CTM-MET/112831/2009. Leading Institution: IST. IST/CTN Coordinator: R.C. Silva (15%). IST/CTN budget (overall): 19932 €.
- *Depth-selective Ion Microprobe Tomography-Tomo3D*. Grant PTDC/FIS /115089/2009. Leading Institution: IST/ITN. PI: A.C. Marques (FCT post-doctoral fellow, 100%). IST/CTN Coordinator: R.C. Silva (30%). Budget (overall): 92322 €.
- *Nobly Decorated Crystal-NobleDec*. Grant AdI/23274/2012, QREN programme COMPETE. Leading Institution: VAA-Vista Alegre/Atlantis. IST/CTN Coordinator: R.C. Silva (20%). IST budget (overall): 102000 €.

COLLABORATIONS

- M. Fraga, P. Fonte, R.F. Marques and LIP-Coimbra, Laboratório de Instrumentação e Física Experimental de Partículas, Coimbra, Portugal. Development and performance tests of prototype gas detector for on-axis STIM tomography.
- M. Ventura, *et al.*, REQUIMTE, Dep. Chemistry, Faculty of Sciences and Technology, Univ. Nova de Lisboa, Monte da Caparica, Portugal. Induction and study of photochromic and luminescence behaviour in hackmanite by thermal reduction.

NAME: Katharina Lorenz

CATEGORY: Auxiliary Researcher (Ciência 2007) until February 2013; Voluntary Researcher March-August 2013; Principal Researcher (FCT), since September 2013.

IST-ID: 5461

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Coordinator of the project "Functionalising wide bandgap semiconductor nanowires using ion beams: Novel materials for nano-light emitters and nano-sensors" funded by FCT (PTDC/CTM-NAN/2156/2012), budget 199.189 Euros, duration: 2013-2015.	23
2	Coordinator of the project "Bandgap engineering of III-nitride quantum wells for efficient green light emitting diodes (Greenlight)" funded by FCT (PTDC/FIS-NAN/0973/2012), budget 178.165 Euros, duration: 2013-2015.	23
3	Coordinator of the project "Ion beam modification and neutron irradiation studies of wide bandgap semiconductor hetero- and nanostructures" funded by FCT (PTDC/CTM/100756/2008), budget 180.000 Euros, duration: 2010-2013.	9
4	Coordinator of the bilateral project "Doping studies of GaN nanowires" with the CEA-Grenoble (EGIDE (France) / FCT (Portugal)), budget 4.000 Euros, duration: 2013-2014.	10
5	Member of team in project "Perturbed Angular Correlations and Electron Channeling Experiments at ISOLDE - applied materials research with nuclear techniques, training and development" funded by FCT (CERN/FP/123585/2011), budget 245.000 Euros, duration: 2012-2014. (coordinated by J.G. Correia)	15
6	Member of team in the project "Free-charge carrier properties and doping mechanisms of InN-based materials" PTDC/FIS/100448/2008 (coordinated by	5

	V. Darakchieva)	
7	Training: supervision of PhD students, research fellows and post-docs; teaching at IST	10
8	Others: Conference organization, participation in academic juries, refereeing of journal papers, evaluation of research projects	5
Total		100

WORK SUMMARY

N°	Work Summary and Main Achievements
1	This project started in Mai of 2013. The main research focus in these first months was lying in the investigation of implantation damage in Ga ₂ O ₃ nanowires and the comparison with bulk single crystals. Furthermore, a new measurement chamber for in-situ I-V-curve measurements during particle irradiation was planned and essential parts purchased.
2	This project started in Mai of 2013. In the first months of the project we studied the structural and optical properties of InGaN quantum well structures and the effect of thermal annealing on their properties. Furthermore, III-N ternary and quaternary films were characterized.
3	Doping by ion implantation and radiation effects in advanced wide bandgap semiconductor structures have been studied with emphasis on low dimensional structures such as quantum dots. Structural and compositional studies of wide bandgap ternary compounds such as AlInN, ZnMgO and ZnCdO were performed using ion beam analysis and X-ray techniques. The project ended in March of 2013.
4	The doping of GaN nanowires by ion implantation was studied with focus on the optical activation of rare earth ions and the effect of implantation defects in low dimensional nanowires.
5	In the frame of this project I am spokesperson for an international collaboration at ISOLDE/CERN (project IS481). During the shut-down period of ISOLDE, measurements using the Perturbed Angular Correlations techniques were performed at the University of Lisbon using diffusion of ¹¹¹ In.
6	My main task within this project is the measurement of unintentional hydrogen doping in III-N layers by Elastic Recoil Detection Analysis as well as their structural characterization by Rutherford Backscattering Spectrometry and Channelling.
7	I have been supervising one PhD student (Sérgio Magalhães who defended his PhD in March of 2013) and on post-doc (Andrés Redondo). In 2013 four new fellows started their contracts within projects: one post-doc (starting in October), one student with master degree (starting in October) and two students with licentiate (starting in November). I was teaching at the Physics Department of IST as an invited professor: <ul style="list-style-type: none"> • Laboratory classes in mechanics and waves for students of Chemistry, Biology and Environmental Studies (2. Semester 2012/2013) • Problem classes in mechanics and waves for students of Informatics and Mining (2. Semester 2012/2013) • Introduction to Research (II) (within the Integrated Masters course in physical engineering and technological physics) (1. Semester 2013/2014)
8	<ul style="list-style-type: none"> • Member of the program committee “Oxide-based Materials and Devices IV”, SPIE International Symposium on SPIE OPTO, 2-7 February 2013, San Francisco, USA • Co-chair of the symposium “Functional Nanowires: Synthesis, Characterization and Applications”, EMRS Spring Meeting, May 27-31 2013, Strasbourg, France. • Guest editor of the proceedings volume of the symposium “Functional Nanowires: Synthesis, Characterization and Applications”, EMRS Spring Meeting, May 27-31 2013, Strasbourg, France. • I evaluated one research project for Marsden Fund Council, New Zealand • I was evaluator of scientific beam time proposals at CENTRO DE MICRO-ANÁLISIS DE MATERIALES at Madrid.

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| <ul style="list-style-type: none"> • I was examiner in one master degree jury and member of the jury in one PhD jury. • I acted as referee for 7 papers. |
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PUBLICATIONS

Journals

1. I. López, K. Lorenz, E. Nogales, B. Méndez, J. Piqueras, E. Alves, J. A. García, “Study of the relationship between crystal structure and luminescence in rare-earth-implanted Ga₂O₃ nanowires during annealing treatments”, *J. Mater. Sci.* 49 (2014) 1279–1285. DOI 10.1007/s10853-013-7811-x
2. A. Redondo-Cubero, K. Lorenz, E. Wendler, D. Carvalho, T. Ben, F.M. Morales, R. García, V. Fellmann, B. Daudin, “Selective ion-induced intermixing and damage in low-dimensional GaN/AlN quantum structures”, *Nanotechnology* 24 (2013) 505717. doi:10.1088/0957-4484/24/50/505717
3. M. Vila, C. Díaz-Guerra, K. Lorenz, J. Piqueras, E. Alves, S. Nappinic, E. Magnano, “Structural and luminescence properties of Eu and Er implanted Bi₂O₃ nanowires for optoelectronic applications”, *J. Mater. Chem. C* 1 (2013) 7920-7929. DOI: 10.1039/c3tc31989j
4. P. Ruterana, M.P. Chauvat, K. Lorenz, “Mechanisms of Damage Formation during Rare Earth Ion Implantation in Nitride Semiconductors”, *Japanese Journal of Applied Physics* 52 (2013) 11NH02. <http://dx.doi.org/10.7567/JJAP.52.11NH02>
5. K. Lorenz, E. Nogales, S. M. C. Miranda, N. Franco, B. Méndez, E. Alves, G. Tourbot, B. Daudin, “Enhanced red emission from Praseodymium doped GaN nanowires by defect engineering” *Acta Materialia* 61 (2013) 3278–3284. <http://dx.doi.org/10.1016/j.actamat.2013.02.016>
6. M.B. Barbosa, J.N. Gonçalves, A. Redondo-Cubero, S.M.C. Miranda, R. Simon, P. Kessler, M. Brandt, F. Henneberger, E. Nogales, B. Méndez, K. Johnston, E. Alves, R. Vianden, J.P. Araújo, K. Lorenz, J.G. Correia, Nanostructures and thin films of transparent conductive oxides studied by perturbed angular correlations, *Phys. Status Solidi B* 250 (2013) 801–808. DOI 10.1002/pssb.201200923.
7. E. Wendler, W. Wesch, A.Yu. Azarov, N. Catarino, A. Redondo-Cubero, E. Alves, K. Lorenz, “Comparison of low- and room-temperature damage formation in Ar ion implanted GaN and ZnO” *NIMB* 307 (2013) 394–398, <http://dx.doi.org/10.1016/j.nimb.2013.01.020>
8. J. Rodrigues, S.M.C. Miranda, M. Peres, E. Nogales, L.C. Alves, E. Alves, G. Tourbot, B. Daudin, B. Méndez, K. Lorenz, T. Monteiro, “A comparative study of photo-, cathodo- and ionoluminescence of GaN nanowires implanted with rare earth ions” *NIMB* 306 (2013) 201–206, <http://dx.doi.org/10.1016/j.nimb.2012.12.028>
9. N. F. Santos, A. J. S. Fernandes, L. C. Alves, N. A. Sobolev, E. Alves, K. Lorenz, F. M. Costa¹, T. Monteiro, “Microprobe analysis, iono- and photo- luminescence of Mn²⁺ activated ZnGa₂O₄ fibres”, *NIMB* 306 (2013) 195–200, <http://dx.doi.org/10.1016/j.nimb.2012.12.029>
10. M. R. N. Soares, M. J. Soares, L.C. Alves, E. Alves, K. Lorenz, F. M. Costa, T. Monteiro, “The influence of photon excitation and proton irradiation on the luminescence properties of yttria stabilized zirconia doped with praseodymium ions”, *NIMB* 306 (2013) 207–211, <http://dx.doi.org/10.1016/j.nimb.2012.11.036>

Conference Proceedings

1. M. Peres, S. Magalhães, M.R. Soares, M.J. Soares, L. Rino, E. Alves, K. Lorenz, M. R. Correia, A.C. Lourenço, T. Monteiro, ”Disorder Induced Violet/Blue Luminescence in rf-deposited ZnO films”, *pss c 10* (2013) 662–666, DOI 10.1002/pssc.201200873
2. J. Rodrigues, S.M.C. Miranda, A.J.S. Fernandes, E. Nogales, L.C. Alves, E. Alves, G. Tourbot, T. Auzelle, B. Daudin, B. Méndez, T. Trindade, K. Lorenz, F.M. Costa, T. Monteiro, ” Towards the understanding of the intentionally induced yellow luminescence in GaN nanowires”, *pss c 10* (2013) 667–672, DOI 10.1002/pssc.201200714
3. K. P. O'Donnell, R. W. Martin, P. R. Edwards, K. Lorenz, E. Alves, and M. Bokowski “Temperature-dependent hysteresis of the emission spectrum of Eu-implanted, Mg-doped HVPE GaN”, *AIP Conference Proceedings* 1566, (2013) 63-64; doi: 10.1063/1.4848286

COMMUNICATIONS

Invited Talks

SPIE Photonics West, OPTO, Oxide-based Materials and Devices III, 2-7 February 2013 in San Francisco, USA:

1. “Cd_xZn_{1-x}O epilayers grown on MgZnO for red to violet emission”, A. Redondo-Cubero, K. Lorenz, E. Wendler, D. Carvalho, T. Ben, F. Morales, V. Fellmann, B. Daudin.

Spring Meeting of the European Materials Research Society (E-MRS), Strasbourg, France, Mai 27 – 31, 2013, Symposium L: Group III nitrides:

2. “The Eu⁰/Eu^I resonance transition in Mg-doped GaN: a new solid state qubit?”, K.P.O'Donnell, P.R. Edwards, K. Lorenz, M. Bockowski.

21st International Conference on Ion-Surface Interactions ISI-2013, 22-26 August 2013, Yaroslavl, Russia:

3. “Ion implantation and rare earth doping of group-III nitride semiconductors”, K. Lorenz.

5th International Conference on Advanced Plasma Science and its Applications for Nitrides and Nanomaterials ISPlasma2013, 28 January -1 February 2013, Nagoya, Japan:

4. “Mechanisms of Damage Formation During Rare Earth Ion Implantation in Nitride Semiconductors”, P. Ruterana, M.P. Chauvat, B. Lacroix, S. Leclerc, K. Lorenz, E. Alves.

XII Iberian Meeting on Atomic and Molecular Physics (Iber2013), 9-11 September 2013, Seville, Spain:

5. “Photoluminescence properties of RE³⁺ in wide band gap materials”, M. R. N. Soares, J. Rodrigues, C. Nico, A. J. S. Fernandes, L. Rino, A. J. Neves, E. Alves, K. Lorenz, F. M. Costa, T. Monteiro.

Contributed Oral Presentations

Spring Meeting of the European Materials Research Society (E-MRS), Strasbourg, France, Mai 27 – 31, 2013, Symposium W: Ion beam applications: new and innovative approaches:

1. “Selective Ion-Induced Intermixing and Damage in GaN/AlN Quantum Structures”, A. Redondo-Cubero, K. Lorenz, E. Wendler, D. Carvalho, T. Ben, F. Morales, V. Fellmann, B. Daudin

17th International Conference on Radiation Effects in Insulators, Helsinki, Finland, June 27 – July 5, 2013:

2. “Terbium implanted Al_xGa_{1-x}N alloys: Damage and optical effects”, E. Alves, M. Fialho, K. Lorenz, T. Monteiro
3. “RBS channelling studies of Ar ion implanted GaN”, E. Wendler, K. Lorenz

10th International Conference on Nitride Semiconductors (ICNS-10), Washington DC, USA, August 25 – 30, 2013:

4. “GaN Double-Doped with Mg and Eu: Beyond the Light Emitting Diode Limit”, K. O'Donnell, V. Kachkanov, K. Lorenz, M. Bockowski

European Congress and Exhibition on Advanced Materials and Processes (EUROMAT 2013), Seville, Spain, September 8 – 13, 2013:

5. “Structural and compositional characterization of InGaN/GaN multilayers grown with unintentionally rough interfaces”, D. Carvalho, T. Ben, F.M. Morales, R. García, S.M.C. Miranda, A. Redondo-Cubero, L.C. Alves, E. Alves, K. Lorenz, P. R. Edwards, K. P. O'Donnell, C. Wetzel
6. “Luminescence of Bi₂O₃ nanowires implanted with Eu and Er ions” C. Díaz-Guerra, M. Vila, K. Lorenz, J. Piqueras, E. Alves

Poster Presentations

Spring Meeting of the European Materials Research Society (E-MRS), Strasbourg, France, Mai 27 – 31, 2013, Symposium L: Group III nitrides:

1. “Sequential multiple step Europium ion implantation and annealing of GaN”, S. M. C. Miranda, P. R. Edwards, K. P. O'Donnell, M. Boćkowski, E. Alves, A. Vantomme, K. Lorenz
2. “Structural and optical characterization of Al_xGa_{1-x}N alloys doped with terbium ions”, M. Fialho, S. Magalhães, J. Rodrigues, A. J. Neves, T. Monteiro, K. Lorenz, E. Alves

Spring Meeting of the European Materials Research Society (E-MRS), Strasbourg, France, Mai 27 – 31, 2013, Symposium P: Functional nanowires: synthesis, characterization and applications:

3. “Orientation, twist and tilt of vertically aligned GaN nanowires grown on silicon”, S.M.C. Miranda, S. Magalhães, G. Tourbot, N. Franco, E. Alves, B. Daudin, K. Lorenz
4. “Enhanced red emission from Praseodymium doped GaN nanowires by defect engineering”, K. Lorenz, E. Nogales, S. M. C. Miranda, J. Rodrigues, N. Franco, B. Méndez, T. Monteiro, E. Alves, G. Tourbot, B. Daudin
5. “Study of the local environment of implanted Cd in Ga₂O₃ nanowires, single- and polycrystals”, M. B. Barbosa, J. N. Gonçalves, E. Nogales, B. Méndez, E. G. Villora, K. Shimamura, J. P. Araújo, K. Lorenz, J. G. Correia

European Congress and Exhibition on Advanced Materials and Processes (EUROMAT 2013), Seville, Spain, September 8 – 13, 2013:

6. “Interface compositional modification by Ar⁺ irradiation in GaN/AlN quantum structures”, D. Carvalho, T. Ben, F. M. Morales, R. García, A. Redondo-Cubero, K. Lorenz, E. Wendler, V. Fellmann, B. Daudin
7. “The role of edge dislocations on the red luminescence of ZnO films deposited by RF-sputtering”, R. Felix, M. Peres, S. Magalhães, M. R. Soares, K. Lorenz, F. M. Morales, R. Garcia, M. R. Correia, A. Lourenço, T. Monteiro
8. “Luminescence of rare earth-implanted MoO₃ nanoplatelets and lamellar single crystals”, C. Díaz-Guerra, M. Vila D. Jerez, K. Lorenz, J. Piqueras, E. Alves

ISOLDE Workshop and Users meeting 2013, CERN Geneva, Switzerland, November 25 – 27, 2013:

9. “Can we dope the wide gap Ga₂O₃ semiconductor? - ion implantation and hyperfine interactions studies” M. B. Barbosa, K. Lorenz, J. G. Correia, J. P. Araújo

Joint ICTP-IAEA Workshop on "Advanced Ion Beam Techniques: Imaging and Characterisation with MeV ions", Trieste, Italy, September 30 – October 4, 2013:

10. “Ion channelling: strengths and limitations in the characterization of semiconductor materials”, A. Redondo-Cubero and K. Lorenz

EDUCATION

Theses Supervision

- Supervisor, PhD. Thesis, *Caracterização e Modificação de Heteroestruturas de Nitretos do Grupo-III*, by Sérgio Nuno Canteiro de Magalhães (FCT BD/44635/2008), Universidade de Aveiro, 20 March 2013 (co-supervisor Prof. Teresa Monteiro).

Jury Membership

- Member of jury in the PhD exam of Dr. Sérgio Nuno Magalhães which took place on the 20th of March 2013 at the Universidade de Aveiro, Portugal. Title: *Caracterização e Modificação de Heteroestruturas de Nitretos do Grupo-III*
- Examiner in the master degree exam of Paulo Manuel Figueiras Forte which took place on the 5th of December 2013 at the University of Aveiro, Portugal. Title: *Síntese e caracterização de nano emissores de YAG:Dy para LEDs*

Teaching

- Laboratory classes in mechanics and waves for students of Chemistry, Biology and Environmental Studies (IST, Mestrado Integrado em Engenharia Biológica, Mestrado Integrado em Engenharia do Ambiente) (2. Semester 2012/2013)
- Problem classes in mechanics and waves for students of Informatics and Mining (IST, Licenciatura Bolonha em Engenharia Informática e de Computadores; Licenciatura Bolonha em Engenharia Geológica e de Minas) (2. Semester 2012/2013)
- Introduction to Research (II) (IST, Mestrado Integrado em Engenharia Física Tecnológica) (1. Semester 2013/2014)

PROJECTS

- *Functionalising wide bandgap semiconductor nanowires using ion beams: Novel materials for nano-light emitters and nano-sensors*, funded by FCT, Grant agreement PTDC/CTM-NAN/2156/2012, Leading Institution: IST, Coordinator: K. Lorenz (35%).
- *“Bandgap engineering of III-nitride quantum wells for efficient green light emitting diodes (Greenlight)*, funded by FCT, Grant agreement PTDC/FIS-NAN/0973/2012, Leading Institution: IST, Coordinator: K. Lorenz (35%).
- *Ion beam modification and neutron irradiation studies of wide bandgap semiconductor hetero- and nanostructures*, funded by FCT, Grant agreement PTDC/CTM/100756/2008, Leading Institution: IST, Coordinator: K. Lorenz (30%).
- *Doping studies of GaN nanowires*, bilateral project with the CEA-Grenoble (EGIDE (France) / FCT (Portugal), IST, Coordinator: K. Lorenz (10%).

CONFERENCE ORGANISATION

- Member of the program committee “*Oxide-based Materials and Devices IV*”, SPIE International Symposium on SPIE OPTO, 2-7 February 2013, San Francisco, USA
- Co-chair of the symposium “*Functional Nanowires: Synthesis, Characterization and Applications*”, EMRS Spring Meeting, May 27-31 2013, Strasbourg, France.

COLLABORATIONS

- Dr. Bruno Daudin, CEA Grenoble, France, 17 June 2013, 13-15 November 2013, Round tables on growth and doping of GaN nanowires
- Dr. Denis Jalabert, CEA Grenoble, France, 13-15 November 2013, Seminar on Medium Energy Ion Scattering

NAME: Carlos Manuel Marques da Cruz

CATEGORY: Auxiliary Researcher

IST-ID: 25356

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Staff Engineer (Chief Engineering of the Instrumentation and Accelerators of LATR)	80
2	Participation of ITN on n_TOF experiments (phase 2) at CERN	5
3	EMRP Project: IND04 MetroMetal	5
4	EMRP Project: IND57 MetroNORM	5
5	"Functionalising wide bandgap semiconductor nanowires using ion beams: Novel materials for nano-light emitters and nano-sensors"	5
Total		100

WORK SUMMARY

N°	Work Summary and Main Achievements
1	<p>1.1 - Responsibilities for inspecting, testing and troubleshooting electronic systems, performing advanced engineering tasks in order to achieve higher reliability and availability of the equipment; Designing and fabricating electronic, mechanical and software interfaces for data acquisition, AMS technique; Calibration, testing, debugging hardware modules, reworking, modifying and inspecting highly complex electronic/electrical instrumentation and automation systems required for research inside and outside CTN; Improvement of electrical installation that serves the instrumentation of the IBL.</p> <p>After notification that several electronic instruments related with the Tandem AMS line operation were not working properly due to problematic noise being injected by ground loops into sensitive circuits, the premises wiring of the A.C. power supply network (mains), was checked and reworked using rules on grounding, shielding and power distribution to minimize noise susceptibility. This work consisted in:</p> <ul style="list-style-type: none"> • Identification of the noise sources: switching power supplies, lightning, servo drives, contactor switching of inductive loads; • Determination of the type of earthing system used in the original electrical installation, removal of the old earth wiring and installation of new earthing conductors. • Optimization of the existing electrical panel with controls and circuit breakers, for power distribution of the voltage and current power supplies. • Inspection and tests for normal operation of conductors, including the phase, neutral and protective earth conductors, attachment plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring (power 400v 3-phase transformers to 208v single phase). <p>Several equipment (vacuum pump controllers and power supplies had their RFI assembly components replaced, mainly the in-circuit capacitors and resistors.</p> <ul style="list-style-type: none"> ➤ Responsibility for acquisition of scientific instrumentation and electronic components. ➤ Assembling between 2 layers of a flange with microdot connectors to interface electronic signals coming from detectors and stepper motors inside a vacuum chamber, to external acquisition equipment for the "Depth-selective Ion Microprobe Tomography - Tomo3D" Project. ➤ Repair, improvements and tests of the microprobe "Scanning power amplifier". <p>Support and technical assistance of the instrumentation connected to the vacuum chamber used in materials studies of the <i>JET experiment</i>.</p> <p>1.2 - SPIRIT Project - development and processing of advanced materials with ion beams. Acquisition of electronic components for the preliminary tests of the A250 preamplifier assembly designed last year. Put into operation and calibration of electronic instrumentation for the <i>UTR facility</i>.</p>
2	<p>This project is the continuation of the involvement of ITN in the activities of the n_TOF Collaboration.</p>
3	<p>EMRP Project: IND04 MetroMetal: Ionising radiation metrology for the metallurgical industry.</p> <p>During 2013 an n-type HPGe detector with a nominal 52.5% relative efficiency and resolution of 1.9 keV (for 1333 keV Co-60 photons), has been characterized and detector parameters were determined. As one of our task we have collected all reports and elaborated the final report. Collaboration of the organization of 2 workshops with the stakeholders and final users. Two abstracts were submitted to an international conference and other two publications are being written.</p>
4	<p>The project started in September 2013 with duration of 3 years. Since the beginning of the project a questionnaire was prepared and sent to the industries to determine currently used devices/systems for measuring the activity of radionuclides in some NORM industries.</p>

5	Design of the electronic circuit diagram and the Printed Circuit Board for I/V curves tracing of the nanowires samples.
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COMMUNICATIONS

- *Establishing an E&T platform on NORM related industries*, I. Paiva, M. Reis, L. Portugal, C. Cruz and C. Oliveira, *Nuclear Education and Training International Conference, NESTet 2013*, November 17-21, Madrid (2013), Oral.

WORKSHOPS

- Workshop “Projecto EMRP: IND04 MetroMetal “Ionizing Radiation Metrology for Metallurgical Industry“. CTN-IST. 3rd April 2013.
- Workshop “Projecto EMRP: IND04 MetroMetal “Ionizing Radiation Metrology for Metallurgical Industry“ for stakeholders and end-users. CTN-IST. 6th December 2013.

NAME: Victoria Corregidor Berdasco

CATEGORY: Auxiliary Researcher (Ciência 2008)

IST-ID: 25463

ACTIVITIES

Nº	Activity Description	R&D (%)
1	Research – Coins: Compositional Study	20
2	Research – Collaboration – Nova University of Lisbon, Portugal	15
3	Research – Collaboration - Autónoma University of México, México	20
4	Research – Collaboration - Autónoma University of Madrid, Spain	10
5	Research – collaboration - Consorcio CREO, Italy	10
6	Training – supervision of PhD student, research fellows and “Ciência Viva”.	25
Total		100

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>Research – Coins: Compositional Study</p> <p>Following the work developed over the last year, the proton beam generated by the 2.5 Van der Graaff accelerator was used to study the composition of silver and gold Portuguese coins from different centuries to develop a database composition of the coins.</p> <p>In this sense, and also in collaboration with R. Borges who is doing his PhD on this topic and with IMC, several Portuguese silver coins were characterized. The coins were also characterized by XRF and results will be compared and discussed.</p>
2	<p>Research – Collaboration – Nova University of Lisbon, Portugal</p> <p>Stained glass from different collections, belonging to Pena Palace were characterized by Ion Beam techniques.</p> <p>Identification and quantification of the main, minor and trace elements were done.</p> <p>Also, the characterization of the stained glass was performed in-situ by portable XRF equipment.</p> <p>From the results, it seems that will be possible to distinguish the collections by minor differences in composition found in the grisailles. Further studies will be done in the future.</p>
3	<p>Research – Collaboration – Autónoma University of México, México</p> <p>In collaboration with Dr. J.L. Ruvalcaba from the Physics Department - Autónoma University of México, different cultural heritage artefacts (silver coins, tiles, paintings or fabrics) were characterized by means of non-destructive characterization techniques such as: Ion beam analysis techniques using an 3 MeV external proton beam, XRF, IR- Raman, or</p>

	EDS/SEM.
4	<p>Research – Collaboration – Autónoma University of Madrid, Spain In collaboration with the Crystal Growth Laboratory from Universidad Autónoma de Madrid (UAM), ZnO thin films grown on lithium niobate substrates were analysed by PIXE, RBS and XRD. It was possible to study the oxygen depth distribution depending on the growth conditions, mainly growth temperature and time.</p>
5	<p>Research – collaboration - Consorcio CREO, Italy CdTe nano-structured layers were grown by Dr. N. Shockinski from Consorzio CREO, L'Aquila (Italy) to obtain low-cost photovoltaic. The influence of the metal alloy used as back electrode and the thickness of the CdTe layers on the I-V curves were studied.</p>
6	<p>Training Master degree co-orientation of. Rita Viegas. Title “Compositional study of inks on manuscripts”. By means of the IBA techniques using the external proton beam set-up combined with XRD, it was possible to characterize the inks of different manuscripts from the beginning of the XX century. PhD Co-orientation. MSc Morgana Streicher. Title “Al influence on the electrical and optical properties of GaInSb crystals grown by Czochralski method”. By means of the IBA techniques, mainly RBS and PIXE, GaSb and GaInSb crystals were characterized. The structural quality of several crystals (with different In content) was also investigated by channeling experiments and XRD. Training Course No. 3094, entitled: 'Podemos determinar a autenticidade de objectos de arte?'. Duration: 5 days. During the internship students participated in data acquisition, identification of the elements present in silver and gold objects and quantification. The students also manufactured ferrogallic inks following ancient recipes. The students also discussed the results obtained and compared with the expected composition.</p>

PUBLICATIONS

- R. Viegas, V. Corregidor, M. T. Peña, E. Alves, L. C. Alves, Preliminary Studies on Iron Gall Inks Composition Using an External Ion Beam, *International Journal of Conservation Science*, 4, 593-602, 2013
- L.C. Alves, V. Corregidor, T. Pinheiro, L. Ferreira, Ion Beam Microscopy: a Tool for Materials, *Microsc. Microanal.* 19 (Suppl 4), 2013, 95-96, DOI: 10.1017/S1431927613001098
- C. Santos, M. Fonseca, V. Corregidor, L.C. Alves, H. Luis, M. Capelão, J.C. Branco, P.A. Carvalho, A.P. Jesus, Investigation of elemental distribution in cat femoral head by nuclear microprobe and SEM for Paget disease of bone studies, *Microsc. Microanal.* 19 (Suppl 4), 2013, 139-140, DOI: 10.1017/S1431927613001013
- J. Cruz, V. Corregidor, L.C. Alves, P.A. Carvalho, M. Fonseca, Analysis of a gold solidus of roman emperor Valentinian I, *Microsc. Microanal.* 19 (Suppl 4), 2013, 79-80, DOI: 10.1017/S1431927613001311
- V. Corregidor, L.C. Alves, J. Cruz, Analysis of surface stains on modern gold coins, *Nuclear Instruments and Methods in Physics Research Section B*, 2013, DOI: 10.1016/j.nimb.2012.11.039
- I. Tissot, M. Tissot, M. Manso, L.C. Alves, M.A. Barreiros, T. Marcelo, M. L. Carvalho, V. Corregidor, M. F. Guerra, The Earrings of Pancas Treasure: analytical study by X-ray based techniques - a first approach, *Nuclear Instruments and Methods in Physics Research Section B*, 2013 DOI: 10.1016/j.nimb.2012.11.054
- V. Corregidor, L.C. Alves, M.A. Barreiros, N.V. Sochinskii, E. Alves, CdTe nano-structures for photovoltaic devices, *Nuclear Instruments and Methods in Physics Research Section B*, 2013, DOI: 10.1016/j.nimb.2012.11.051
- V. Corregidor, J. Cruz, L.C. Alves, Ion Beam Analytical Techniques applied to the Study of Valuable Artefacts, Proceedings of 1st International Conference on Innovation in Art Research in Technology, 10-13 July 2013, Évora, Portugal.

COMMUNICATIONS

- *Gold layers characterization by Ion Beam Analytical Techniques: from Semiconductors to cultural heritage artifacts*, V. Corregidor, L.C. Alves, *Microscopy in Research 2013, December 9-10, 2013, Monte da Caparica, Portugal*. Oral presentation
- *Ion Beam Analytical Techniques applied to the Study of Valuable Artifacts*, V. Corregidor, J.Cruz, L.C. Alves, *International Conference on Innovation in Art Research and Technology, July 10-13, 2013, Evora Portugal*, Oral presentation
- *IBA techniques at CTN, Lisbon, Instituto de Física, Universidad Nacional Autonoma de México, March 5, 2013*, Invited Seminar.
- *Tesouro da Vidigueira: os segredos revelados por um feixe de protões*, V. Corregidor, L.C. Alves, *Escola Gil Vicente, May 15, 2013 Lisbon, Portugal* Oral presentation,
- *Compositional characterization of iron gall inks in manuscripts*, V. Corregidor, R. Viegas, N. Franco, M. T. Peña, E. Alves, L.C. Alves, *Microscopy in Research 2013, December 9-10, 2013, Monte da Caparica, Portugal*. Poster presentation
- *Microscopy techniques for dye distribution in DSCs nanocrystalline TiO₂ films*, M. A. Barreiros, S. Sequeira, L. C. Alves, V. Corregidor, F. Guimarães, J. Mascarenhas, M. J. Brites, *International Conference on Innovation in Art Research and Technology, July 10-13, 2013, Evora Portuga*. Poster presentation.
- *Preliminary Studies on Inks composition using an External Ion Beam*, V. Corregidor, R. Viegas, T. Pena, E. Alves. L.C. Alves, *International Conference on Innovation in Art Research and Technology, July 10-13, 2013, Evora Portugal*, Poster presentation.
- *Compositional studies of ZnO films on lithium niobate single crystals*, V. Corregidor, L.C. Alves, J.L. Plaza, O. Martinez. E. Dieguez, E. Alves, *21th Ion Beam Analysis Conference, June 23-28 2013, Seattle USA* Poster Presentation.
- *Studies on GaInSb grown by LEC method*, M. Streicher, V. Corregidor, L.C. Alves, N. Franco, E. Alves, E. M. Costa, B.A. Dedavid, *Materiais 2013, March 25-27 2013, Coimbra, Portugal*, Poster Presentation.
- *Compositional characterization of GaInSb grown by LEC method*, M. Streicher, V. Corregidor, L.C. Alves, E. Alves, E. M. Costa, B.A. Dedavid, *13Th International Conference on Particle Induced X-ray Emission, Gramado, Brazil, March 3-8, 2013* Poster Presentation.
- *On the evolution of silver tarnishing*, V. Corregidor, J. Cruz, P.C. Chaves, M.A. Reis, N. Franco, L.C. Alves, *13Th International Conference on Particle Induced X-ray Emission, Gramado, Brazil, March 3-8, 2013*, Poster Presentation.

EDUCATION

Theses Supervision

- Supervisor, PhD Thesis, *Influência do Al nas propriedades eléctricas e ópticas em cristais de GaInSb obtidos pelo método Czochralski*, Morgana Streicher, Responsável português programa CAPES, Doutoramento em Engenharia e Tecnologia de Materiais, Pontifícia Universidade Católica do Rio Grande do Sul, Brasil.
- Supervisor, MSc Thesis, *Estudo composicional de tintas em manuscritos do património cultural*, Rita de Figueiredo Viegas, Instituto Superior Técnico.
- Supervisor Fellowship “Ciência Viva”, Nº 3094, *‘Podemos determinar a autenticidade de objectos de arte?’*

Jury Membership

- Jury PhD Thesis, Universidade Autónoma de Madrid, Espanha. Título: “The effect of Crystal Growth Conditions and Surface Treatment on CdZnTe bulk Single Crystal”, Hakima Bensalah. June 2013.

PROJECTS

- *Estudo às escalas nano e micrométricas de ossos Pagéticos*, EXPL/BBB-BMD/2520/2013. Leading Institution: IST/CTN. Submetido à FCT.

COLLABORATIONS

- J.L. Rubalcaba, Autónoma University of Mexico. Collaboration: characterization of cultural heritage artifacts by means of non-destructive techniques.
- B. deDavid, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga, 6681 – Porto Alegre/RS Brasil, Collaboration: characterization of GaSb and GaInSb single crystals.
- E. Diéguez, Autónoma University of Madrid, Spain, Collaboration: characterization of contacts on CdZnTe crystals.
- J.L. Plaza, Autónoma University of Madrid, Spain, Collaboration: characterization of ZnO nano structures
- N. Shockinski, Consorzio CREO, L'Aquila (Italy). Collaboration: ion beam techniques applied to CdTe nano-structures.
- O. Martínez, University of Valladolid, Spain. Micro PL-Raman characterization of optoelectronic materials.
- M. A. Barreiros, Laboratório Nacional de Energia e Geologia, Lisboa, Portugal, Collaboration: characterization of TiO₂ nano-structures for optoelectronic devices.
- L. Penalva, Museu Nacional de Arte Antiga, Portugal. Characterization of silver objects by Ion beam techniques.
- A.Candeias, Laboratório Hercules, Universidade de Évora. Characterization of Cultural Artifacts.
- M. Vilarigues, Vicarte, Dept. of Conservation and Restoration from FCT-UNL Characterization of glass objects by Ion beam techniques.
- A.P. de Jesus and group, CFNUL. Characterization of biological samples (bones) by Ion beam techniques.
- I.Tissot, M. Tissot, Museu de Arqueologia, Portugal, Characterization of gold objects by Ion beam techniques.
- Imprensa Nacional - Casa da Moeda, Portugal.