Centre of Physics University of Minho (CFUM)

www.fisica.uminho.pt

Introduction

- CFUM was created in 1994 by the University of Minho (UM), including all the staff members of the UM Department of Physics and some academic visitors doing research in Physics and adjacent areas.

- 1994-2002: member of the Institute of Materials (IMAT) and funded by the FCT through IMAT.

- Since 2003: recognised, evaluated and funded by the FCT as independent research unit.

- Since 2015: a part of the Centre of Physics of the Universities of Minho and Porto (CF-UM-UP).

Minho University

School of Science (ECUM)

Centro de Física

≈ 50 teachers of the Physics Department

3 teachers from other Universities

>20 full time researchers with PhD

(3 Research Professors + 20 Post-Docs)

Research students with fellowships

Physics Department

≈ 50 teachers

8 technicians

Research Units

≈ 50 PhD students (≈ 30 enrolled at ECUM), >50% shared with other units

Teaching Units

Organisational structure

CFUM is organised in three Research Lines:

LINE 1: Assessment and enhancing visual performance
12 staff members, 2 Post-Docs, 9 PhD students
Coordinator: José Manuel Gonzalez Meijome

LINE 2: Plasmonic, luminescent, magnetic and hybrid nanostructures for optoelectronic, biomedical and environmental applications
18 staff members, 4 Post-Docs, 12 PhD students
Coordinator: Paulo José Gomes Coutinho

LINE 3: Functional and smart materials and surfaces for advanced applications
17 staff members, 14 Post-Docs, 28 PhD students
Coordinator: Senentxu Lanceros-Mendez

Research facilities

Facilities for:

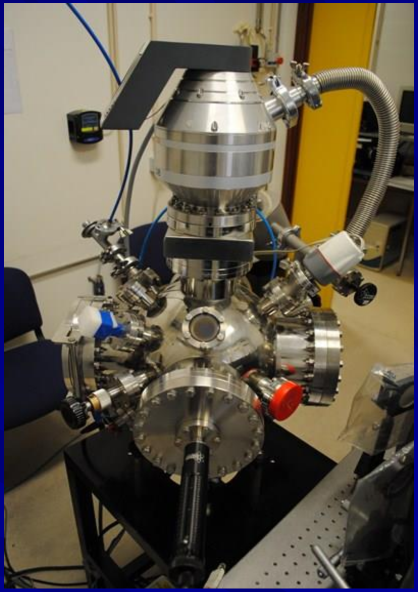
- Growth of thin films, coatings and nanostructures (RF-sputtering, laser ablation, sol-gel, electro-spinning)
- Materials characterisation (XRD, SEM, AFM,…)
- Optical spectroscopy (UV-vis-IR absorption, PL, Raman, FTIR)
- Non-linear optical properties
- Time-resolved spectroscopy
- Electrical and thermal transport measurements
- Mechanical properties measurements
- Dielectric properties, Faraday effect
- Optometry and colorimetry
- Large-scale computations

≈ 30 research laboratories (≈ 20 in Braga, ≈ 10 in Guimarães)

+ UM Laboratory for Materials Characterisation Services (SEMAT)

Research facilities

Thin film deposition

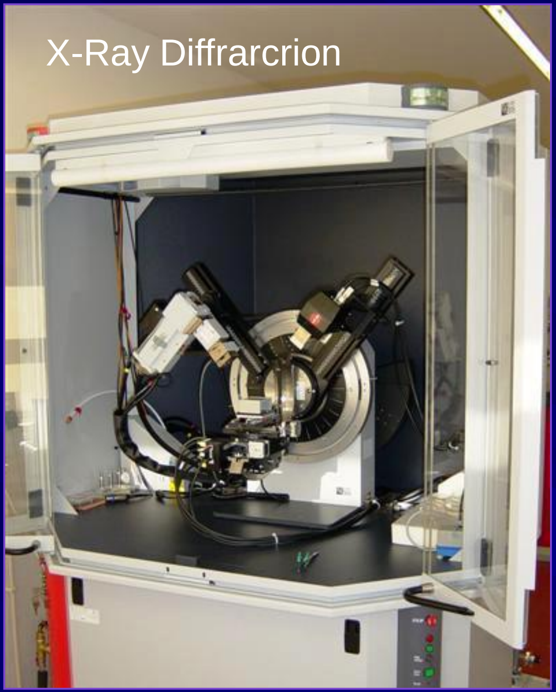


Two magnetron sputtering systems: (Left) Closed field unbalanced magnetron sputter chamber for the deposition of metallic and ceramic coatings on 3D substrates; (Right) Another chamber optimised for deposition of metal oxides onto 2D substrates.

Pulsed Laser Ablation Deposition System: Substrate heater, target carrousel and a high energy KrF excimer laser (248nm) from Coherent Lambda Physics LPX 305.

Research facilities

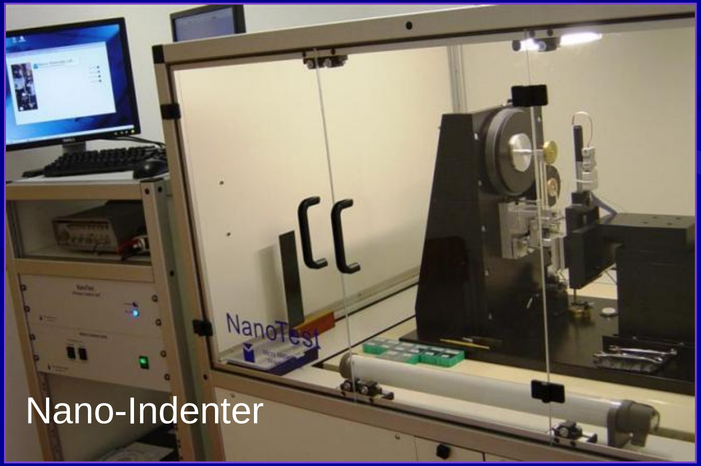
Universidade do Minho
Escola de Ciências / Escola de Engenharia



Materials characterisation:

SEMAT Laboratory

Ciência.Inovação 2010
Programa Operacional Ciência e Inovação 2010
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR



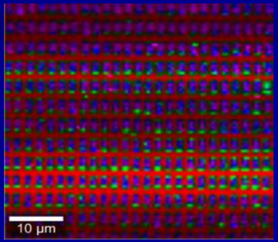
Research facilities

Spectroscopies

Spectrofluorometer

Spectrophotometer (UV-vis-NIR)

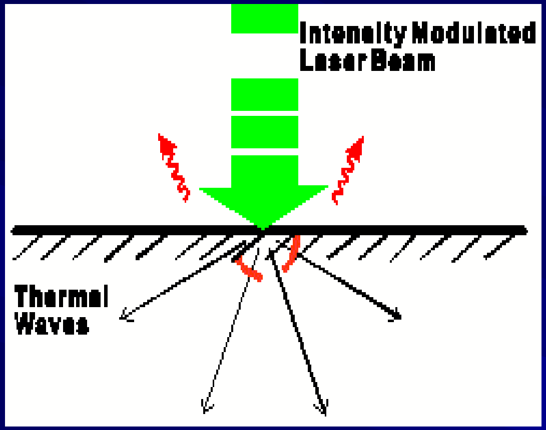
Micro-Raman system:
2D mapping of characteristic vibration modes of layers and coatings, e.g, graphene

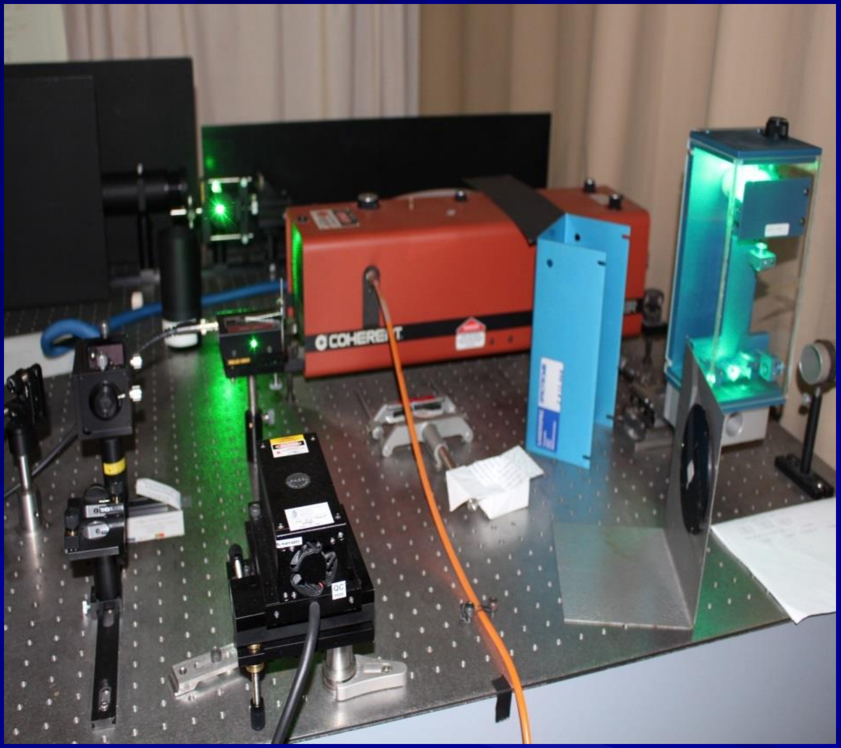


IR FTIR Spectrometer:
IR transmission and reflection measurements in the spectral and temperature ranges of 10000-20 cm^{-1} and 20K to 500K, respectively.

Research facilities

Photothermic techniques





Non-stationary photothermic techniques:
Determination of thermal properties and absorption coefficients of materials through modulated optical excitation and measuring response designated by “thermal waves”.

Contactless temperature measurements:
Using light deflection by heated sample (“mirage effect”)

Some research activities

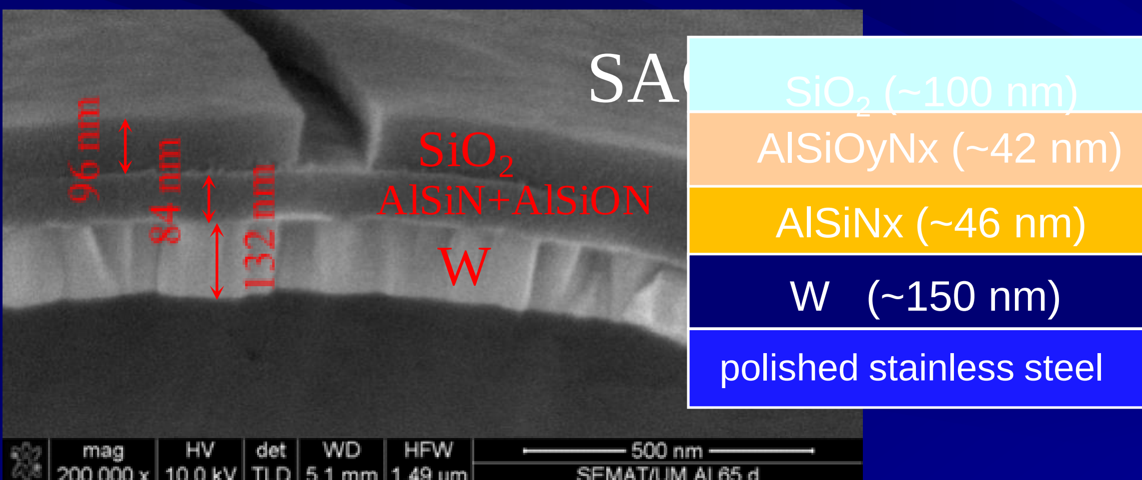
- Theory and modelling of the electronic and optical properties of graphene and other nanomaterials
- Nanoplasmonics: theoretical studies and applications
- Development of new materials and designs for new generation solar cells
- Metallic and semiconductor nanoparticles for applications in electronics, environement control ans preservation, and biology
- Semiconductor oxide films for transparent electronics and energy applications
- New electroactive materials for applications in sensors and actuators
- Oxynitrides: hard coatings of “on demand” color
- New technologies for biocompatible materials
- Colour vision and perception (collaboration with IBILI)
- Contactology and optometry of contact lenses

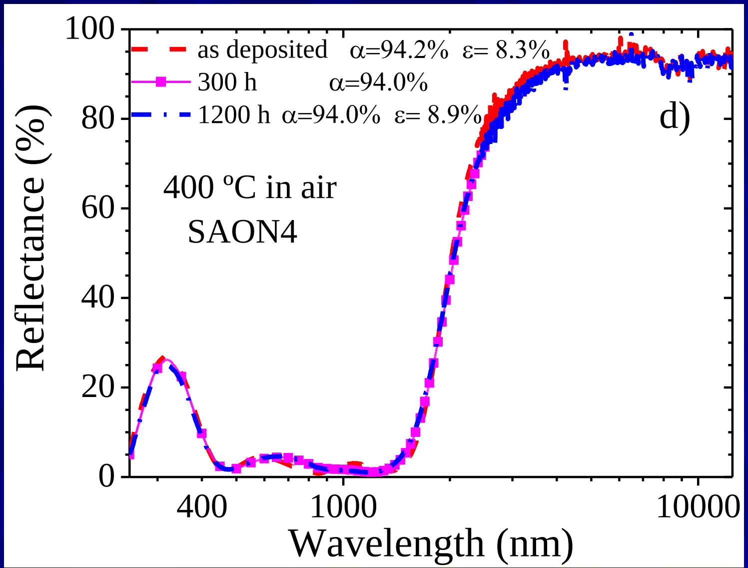
Solar selective absorber coatings for high temperature applications

Solar Energy Materials & Solar Cells

Solar selective absorbers based on Al_2O_3:W cermets and AlSiN/AlSiON layers

L. Rebouta [a,*], A. Sousa [a], P. Capela [a], M. Andritschky [a], P. Santilli [b], A. Matilainen [b], K. Pischow [b], N.P. Barradas [c], E. Alves [d]





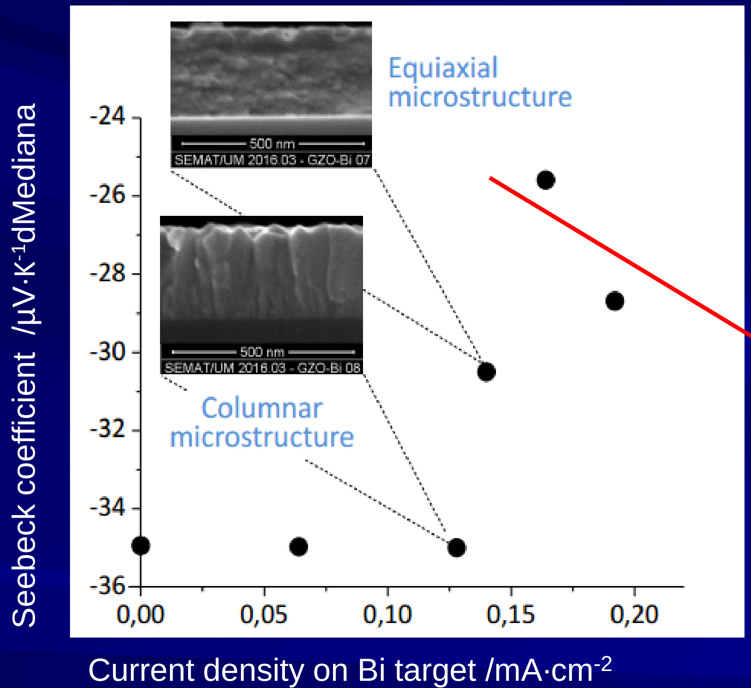
(b) Reflectance of as deposited coatings and after the annealing at 400 ºC in air. The solar absorptance and the thermal emittance at 400ºC are indicated.

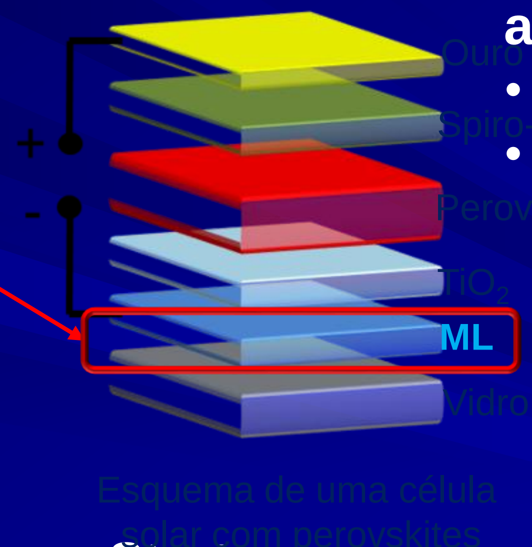
(a) Fractured cross section SEM images of a solar selective absorber coating

Coatings with high absorption of solar radiation, low emissivity at a given temperature of operation and long term stability (Luis Rebouta, Martin Andritschky)

Multilayer structures: conductive, transparent and thermoelectric

Nanostrctured thin flims integrated into multi-layer structures based on Bi/Ti/Zn oxides





Principal applications:

- **Touch screens**
- **Hybride solar cells**

(Carlos Tavares)

Strategy:

Introduction of interfaces in the multilayer structure in order to decrease the conductivity without deteriorating the thermal conductivity

Decorative coatings with advanced mechanical properties

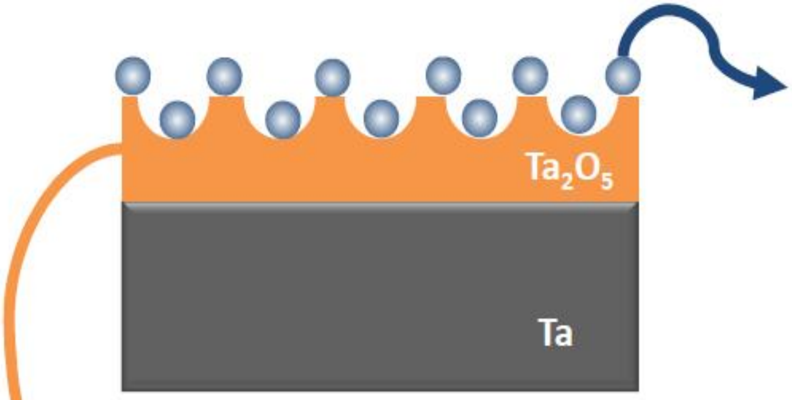



(Filipe Vaz, Luis Rebouta)

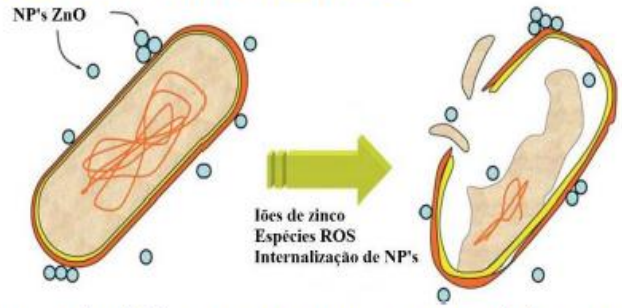



Hard colored nanomateriais produced by sputtering

Bioactive and antimicrobian surfaces

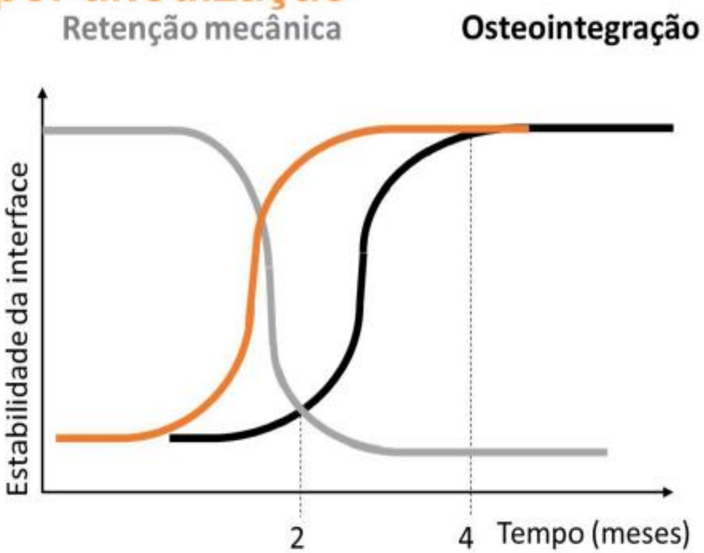


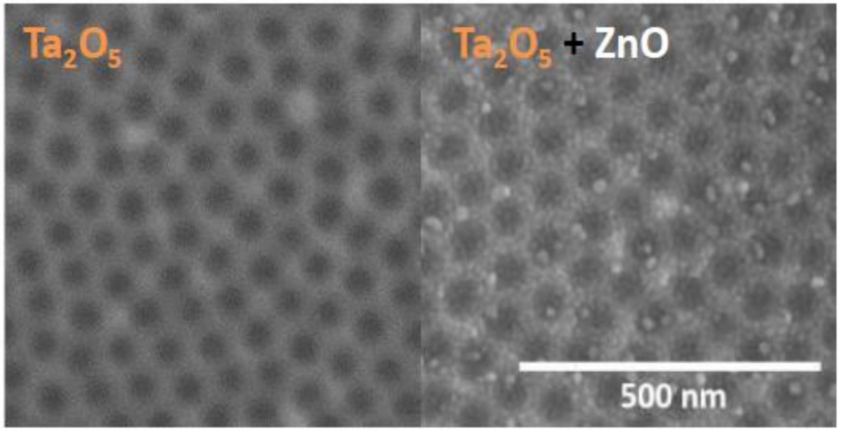
ZnO → Agente antibacteriano depositado por pulverização catódica em magnetrão



A.B. Djurišić, Y.H. Leung, A.M. Ching Ng, Mater. Horizons. 1 (2014) 400.

Ta_2O_5 → Material bioativo obtido por anodização





(Sandra Carvalho)

Self-cleaning surfaces using photocatalytic effect

Deposition of TiO_2 nanoparticles (NPs) using RF sputtering and sol-gel technique;

Studies of the photocatalytic effect produced by UV illumination of NPs, which helps to remove polution from surfaces (Carlos Tavares)