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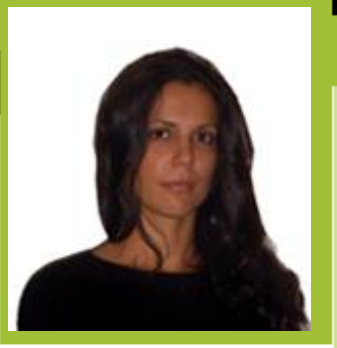
FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Materials Science Department - CENIMAT/I3N

Plasmonic Nanoparticles for Si solar cells

CENIMAT/I3N Microelectronic and Optoelectronic Group



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Objectives

This program aims to the development of Si photovoltaic cells having a plasmonic layer of metallic nanoparticles (MNP). This new method to achieve light scattering (Fig.1), aiming to exploit the mesoscopic architecture proposed to resolve the "thick-thin" conundrum of today's silicon solar cell technology. By doing so, we can contribute to overcome the today's efficiency limitations related to the use of physically thin silicon solar cells by making them optically thick.

The developed plasmonic layer, will be applied to crystalline Si heterojunction solar cells, such as ZnO/Si and HIT and to microcrystalline Si solar cells with the objective of decreasing the physical thickness of the absorbing layer while increasing the cell efficiency.

Methodology

▪The simplest way to form MNP on a substrate is by thermal evaporation of a thin (4 – 20 nm) metal film, which is then heated at a moderate temperature (170–250 °C).

▪Individual layers and plasmonic structures will be characterized by measuring their optical absorption spectra using a UV–Vis spectrometer, spectroscopic ellipsometry, SEM, XRD, EDAX, XPS, AFM, FTIR and Raman measurements.

▪The solar cells will be characterized by measuring its, C-V and J-V characteristic in dark and calibrated illuminated conditions, and by external quantum efficiency (EQE) measured by a dedicated spectral response system.

Expected Results

▪Tune the surface plasmon resonance peak of metal nanoparticles for the design of light trapping layers that target the long wavelength regions where transmission losses are most significant for thin Si solar cells.

▪Examine the nanoparticles properties when it grows in different types of layers. These different types of layers to grow the nanoparticles will be crucial to understand the behavior of the nanoparticles according to the position they will be placed in solar cells.

▪Improve the Silicon solar cells with metallic nanostructures to achieve light trapping with the objective of reducing the absorber-layer thickness while improving cell performance.

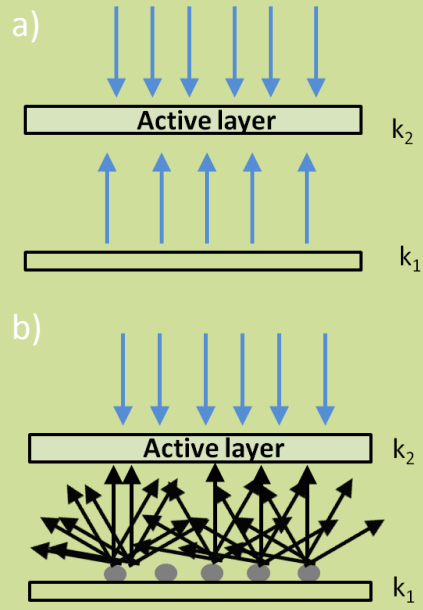

Fig.1 Light trapping improvement with metal nanoparticles

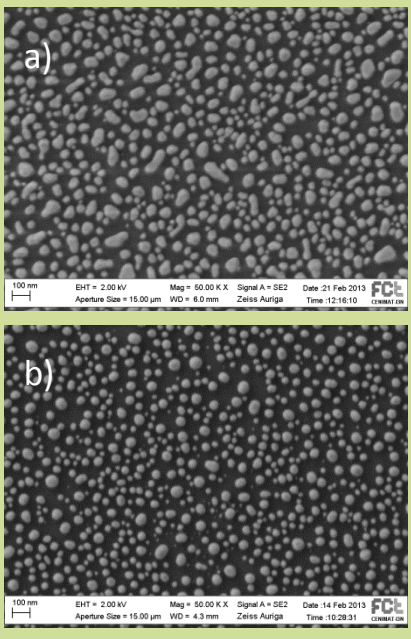

Fig.2 Ag 4nm mass thicknesses annealed at 400 (a) and 500 C° (b).

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