

MASTER IN PHOTONICS – PHOTONICS BCN EUROPHOTONICS-POESII MASTER COURSE

PROPOSAL FOR A MASTER THESIS

Dates: April - September 2017

Laboratory : Institute of Materials Science of Barcelona ICMAB - CSIC
Institution: CSIC – Spanish Council for Scientific Research
City, Country : Barcelona, Spain

Title of the master thesis:

Enhanced Optical Absorption of Germanium Thin Films by Excitation of Multiple Photonic Resonances

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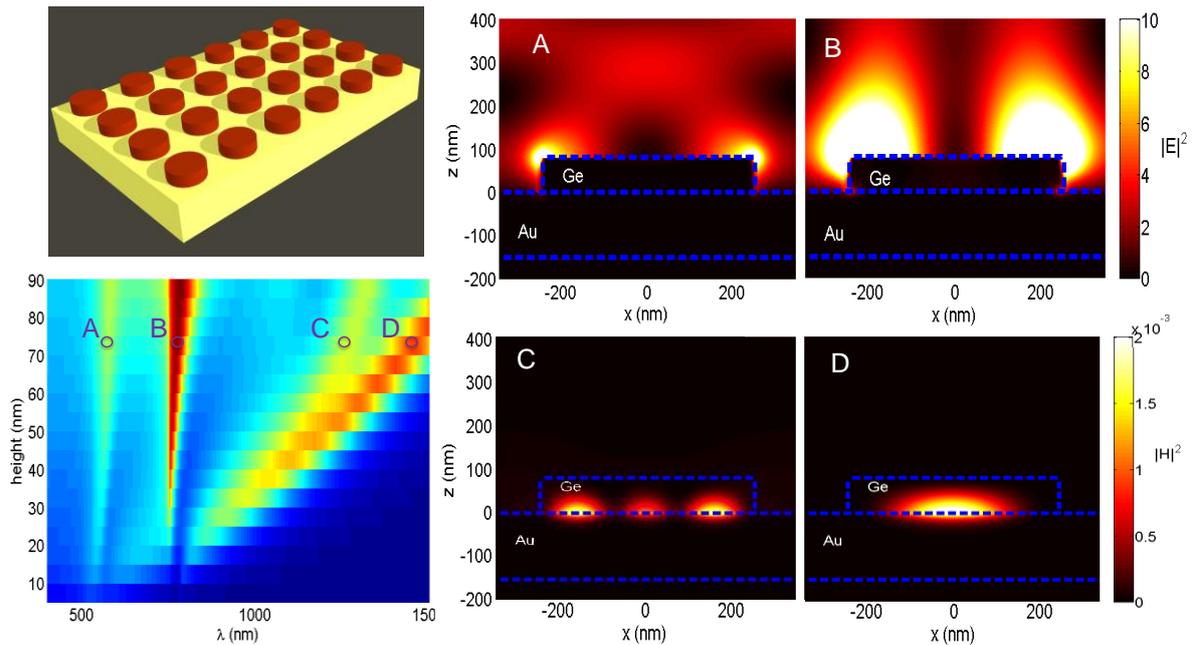
Summary of the subject (maximum 1 page) :

Keywords :

Nanostructured dielectric and metallic photonic architectures can concentrate the electric field through resonances, increase the light optical path by strong diffraction and exhibit many other interesting optical phenomena that cannot be achieved with traditional lenses and mirrors. The use of these structures within actual devices will be most beneficial for enhanced light absorption in thin solar cells, photodetectors and to develop new sensors and light emitters. [1, 2]

This master thesis proposal targets the design, fabrication and characterization of Germanium photonic architectures exhibiting enhanced absorption in a broad spectral range VIS-NIR while having thicknesses below typical diffusion carrier lengths. Such architecture will enable the exploitation of new solar cells and photodetectors with really thin semiconductor layers (below 100nm) thus excellent carrier collection efficiencies while maintaining strong optical absorptions. The project will involve the following steps: first, the theoretical modelling of the photonic architecture and the exploration of different optical resonances the system can sustain (see figure). Second, Ge photonic architectures will be fabricated via MBE deposition and soft lithography. Third, the prototypes will be characterized optically by VIS-NIR spectrometry and electrically with a spectral response set up.

Numerical simulations



Electric and magnetic modes of an array of cylinders of Germanium on a Gold substrate, as a function of the height of the cylinders for normal incidence from top. A and B are Bragg modes of the lattice and C and D are magnetic modes due to the thickness interference.

Electric and magnetic modes of an array of cylinders of Germanium on a Gold substrate, as a function of the height of the cylinders for normal incidence from top. A and B are Bragg modes of the lattice and C and D are magnetic modes due to the thickness interference.

References:

1. **A Mihi**, FJ Beck, T Lasanta, AK Rath, G Konstantatos. 2014 Imprinted Electrodes for Enhanced Light Trapping in Solution Processed Solar Cells. *Advanced Materials*. 26, 443-448.
2. FP Garcia de Arquer, **A Mihi*** and G Konstantatos*. 2015 Large-Area Plasmonic-Crystal-Hot-Electron-Based Photodetectors. *ACS Photonics* 2 (7), 950-957