

## MASTER IN PHOTONICS – PHOTONICS BCN EUROPHOTONICS-POESII MASTER COURSE

### PROPOSAL FOR A MASTER THESIS

**Dates: April - September 2017**

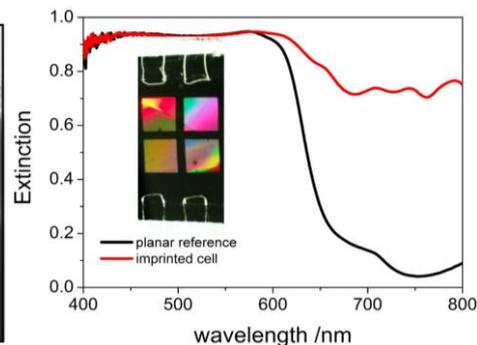
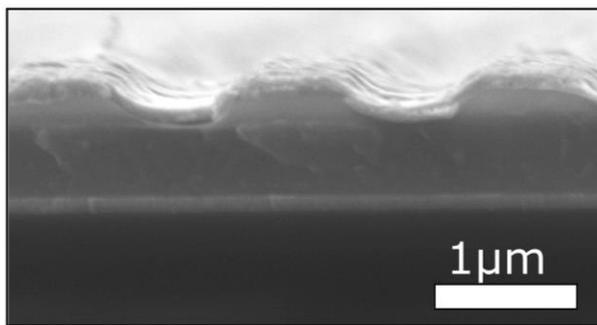
**Laboratory :Institute of Materials Science of Barcelona (ICMAB)  
Institution:Consejo Superior de Investigaciones Cientificas (CSIC)  
City, Country : Bellaterra, Barcelona, Spain**

**Title of the master thesis: Enhancing light harvesting in organic photovoltaics by photonic nanostructures**

**Name of the master thesis supervisor: Mariano Campoy-Quiles & Agustin Mihi**  
Email address: [mcampoy@icmab.es](mailto:mcampoy@icmab.es); [amihi@icmab.es](mailto:amihi@icmab.es)  
Phone number: +34 935 801 853  
Mail address: ICMAB-CSIC, Campus UAB, Bellaterra, 08193, Barcelona, Spain

### **Summary of the subject (maximum 1 page) :**

This project combines two of the most promising technologies developed during the last years, namely, organic photovoltaics (OPV) and photonic structures. OPVs are attracting widespread interest from academia and companies alike due to their potential for low cost, light weight, flexibility and the possibility of tuning their transparency and colour. As all third generation PV technologies, the active layer is often very thin, ca 100 nanometers. This has the limitation that only a fraction of available sun light is absorbed [1]. A possible solution lies in the use of photonic structures, such as periodic gratings, that could enhance the light harvesting by coupling a larger amount of the incident electromagnetic radiation within the active layer [2]. To keep processing cost down, soft lithography is the preferred choice for templating the active layer. An example of a structured organic solar cells is shown in the figure. The aim of the project is to develop a method of stamping the photonic structures that increases the absorption while avoiding shunts in the structure. The project involves fabrication and characterization of solar cells using state of the art facilities and materials, nanostructuring through soft lithography, characterization of the different layers using spectroscopy and microscopy and correlation of all the different techniques.



*Exemplar structured OPV based on a P3HT: PC61BM blend. Scanning electron microscopy (left) allows to observe the structured active layer composed of polymeric nanopillars. FTIR spectroscopy (right) shows that optical extinction is dramatically enhanced in a structured OPV versus a planar reference. The inset shows a typical aspect of these cells.*

**Keywords : Organic Solar Cells, Photonic Crystals, Soft lithography**

References:

1. M. S. Vezie, S. Few, I. Meager, G. Pieridou, B. Döring, R. S. Ashraf, A. R. Goñi, H. Bronstein, I. McCulloch, S. C. Hayes, M. Campoy-Quiles & J. Nelson, *Exploring the origin of high optical absorption in conjugated polymers*, *Nature Materials*, **15**, 746–753(2016)
2. 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 (2014)

**Additional information :**

\* Required skills:

- High qualification in a degree in Physics, Chemistry, Material Science or Engineering
- High level of English (both written and spoken)
- Strong commitment to team work, scientific ethics, and scientific excellence
- Strong motivation for research, and for energy related applications in particular.
- Notions of optics and spectroscopy

\* Miscellaneous :