Cellulose based photonic architectures

Camilla Dore
C. Dore, A. Espinha, C. Matricardi, M. I. Alonso, A. R. Goñi, A. Mihi

Institut de Ciència de Materials de Barcelona, Consejo Superior de Investigaciones Científicas, Carrer dels Til·lers S/N, Campus de la UAB, 08193 Bellaterra, Barcelona, Spain

cdore@icmab.es

Cellulose is the most abundant polymer on Earth and for centuries has had a wide technological impact in areas such as textile, packaging or knowledge storage. It is biodegradable, biocompatible and possesses excellent mechanical characteristics that have raised the interest of many engineering fields [1]. The versatility of cellulose has opened new venues in advanced materials in electronics, energy or biological applications [2]. Here we introduce a cellulose derivative as an eco-friendly and water developable resist. We combine cellulose with nanoimprinting lithography (NIL), the most promising method for mass-produced inexpensive nanostructures over large areas and with a very low density of defects [3]. Using cellulose as a resist and NIL, we are able to pattern silicon wafers or fabricate metallic nanoparticle arrays using water as the only solvent. Furthermore, we revolutionize the field of transient photonics by directly moulding the cellulose itself into photonic and plasmonic architectures and illustrate their outstanding performance in several applications such as structural colours, photoluminescence enhancement and as disposable Surface Enhanced Raman Scattering substrates.

References

[1] Hoeng, F. et al. Nanoscale 8, (2016)13131-13154
[2] Polavarapu, L. et al. Phys. Chem. Chem. Phys. 15 (2013) 5288-5300 .
[3] J. A. Rogers, H. H. Lee, Wiley-Blackwell, Oxford (2009).

Figures

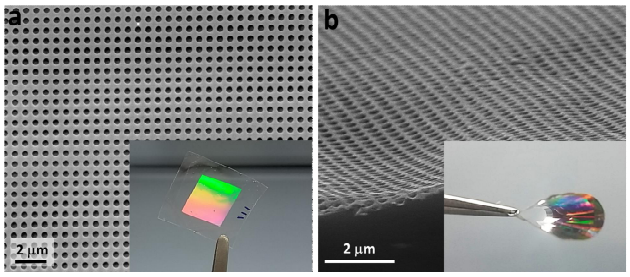

Figure 1: SEM of Cellulose based Photonic (a) and Plasmonic (b) crystals. A photograph of each sample is included as an inset for each case; patterned areas are 1x1 cm2

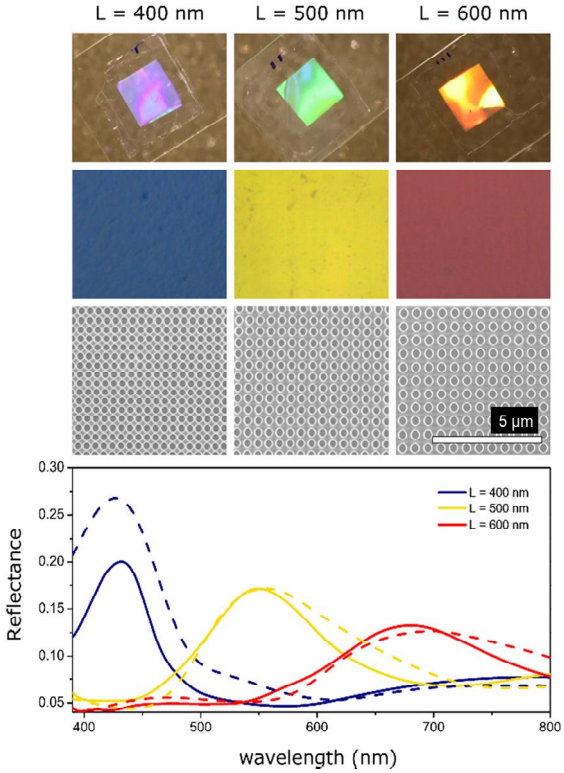

Figure 2: HPC photonic crystals present iridescent colours that depend on the lattice parameter of the nanoimprinted structure.