The coupling of excitons and plasmons in nanoimprinted 2D polymer-based photonic crystals.

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Nanoimprint lithography (NIL) is one of the emerging nanofabrication processes and has been proposed as the next generation of high-resolution lithography thanks to the high volume and cost-effective patterning technique with sub-10 nm resolution. One advantage of NIL is to emboss polymers to be used directly as functional components. For instance, we demonstrated the capability of NIL to fabricated polymeric waveguide, Mach-Zender interferometer, two-dimensionnal (2D) photonic crystals for light extraction applications (Fig. 1a) and 2D band-edge lasers (Fig. 1b) from dye chromophores loaded in a printable polymer.

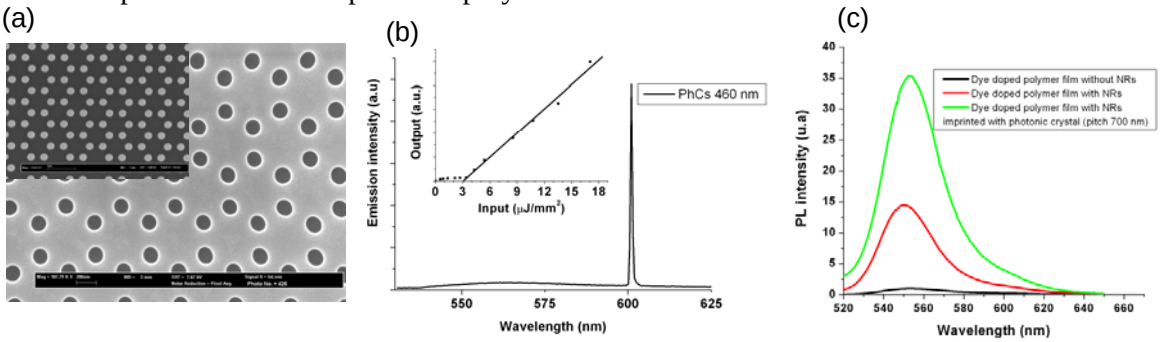

Fig. 1: a/ SEM micrographs of nanoimprinted photonic crystals in mr-l 6000, in which rhodamine 6G have been incorporated (concentration: 5.10^{-3} mol.L^{-1}), Inset: SEM micrographs of a silicon stamp containing two-dimensional honeycomb array of pillars b/ Emission spectra of a band edge laser (lattice constant: 460 nm). Inset: Radiated power as a function of the excitation energy. c/ PL spectra of the dye doped polymer film with and without Au nanorods (red, black), PL spectra of dye doped polymer film with Au nanorods imprinted with 2D photonic crystal (pitch 700 nm)

A particular attention has been given to exploit colloidal metallic and semiconducting nanoparticules (NPs) properties in nanofabrication processes towards their use in devices for photonic applications. The possibility to couple excitons-plasmons for enhancement of spontaneous emission (Fig. 1c) without altering their structural and chemical-physical properties will be discussed. A 35-fold enhancement of PL intensity at room temperature is achieved in a 2D PhC containing dye in the vicinity of Au nanorods surface plasmons compared to an unpatterned sample on a glass substrate.

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