Two and three dimensional polymer devices by means of Nanoimprint Lithography

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Nanoimprint lithography (NIL) is a top-down, parallel lithography technique based on the mechanical deformation of a thin polymer material from a rigid stamp which incorporates micro/nano features or structures. NIL is a feasible, low cost, high resolution and high throughput technique which has been generating increasing interest over the last several years. In this paper we present results in the fabrication and characterization of polymer photonic devices by means of NIL. In particular, two dimensional photonic crystals (PhCs) structures have been studied as efficient light extractors. In this context, new functional materials, able to combine novel tailored physical and chemical properties with versatile and reliable processing capabilities, have been used. An enhancement of the light collection (PL intensity) of up to 2.4 is achieved compared to an unpatterned sample (Fig. 1a). In a second approach to increase even more the light-emission efficiency of imprinted organic thin films, the interplay between PhCs and coupled surface plasmons (SP) was tested. A proof of concept was obtained matching the metal SP energies to the rhodamine 6G emission bands. A 27-fold enhancement of PL intensity at room temperature is achieved in a 2D PhC containing dye in the vicinity of Ag SPs compared to an unpatterned sample on a glass substrate.
Finally we discuss the use of NIL for the three dimensional integration of devices for a full plastic photonic circuit. A novel nanofabrication technique, based on ultraviolet NIL and reversal NIL, has been developed to achieve cost efficient and high throughput three dimensional patterning. Figure 1b shows a top view scanning electron microscope image of a three-layer woodpile structure.

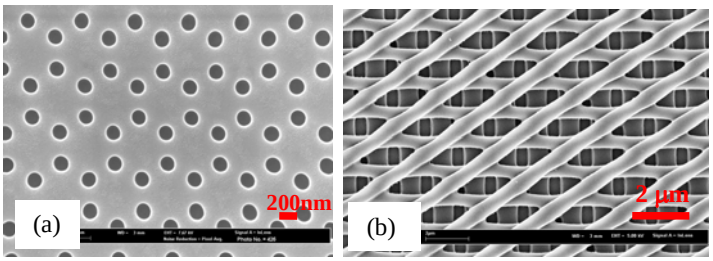

Figure 1 *(a) SEM micrographs of an imprint in the composite polymer $PMMA_{70}$-co-$DMEAMA_{30}$ with (CdSe)ZnS nanocrystals, (b) SEM images of a three-layer woodpile-like structure fabricated by the reverse contact imprinting technique*

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