A novel route for fabricating Printable Photonic Devices with a high refractive index

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The nanopatterning of high refractive index optical films promises the development of novel photonic nanodevices such as optical integrated circuits, imaging sensors and solar cells. Here, we demonstrate a novel strategy for patterning inorganic films by combining bottom-up (inorganic sol-gel chemistry) and top-down (printing process) methods [1]. Our technology allows for the direct printing of optical films with unmatched resolution and optical properties.

A specific imprint resist based on a hybrid of the organic/inorganic TiO_2 resist was synthetized for crack free films with high optical transmission. The imprinting process is performed by UV light at a low pressure. Sub-10 nm resolution was achieved, making this process a state-of-the-art technique for patterning functional films (see Figure 1) [2]. Thermal annealing allows the tuning of the optical properties tuning over a wide range of values; a: refractive index higher than 2.2 and an extinction coefficient close to zero can be achieved in the visible wavelength range. The high etching resistance of the imprinted films allows for easy pattern transfer into other active layers to build multi-level functional films. Examples of photonic nanostructures and devices directly imprinted into TiO_2 films are presented (Figure 2) and their optical characterization will be discussed.

Our technology opens a new route for fabricating novel printable photonic devices based on nanophotonic structures with high refractive index.

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References:

[1] C. Peroz, et al. ***Advanced Materials*** *21 555 (2009)*

[2] C. Pina Hernandez, et al. "A Route for Fabricating Printable Photonic Devices with Sub-10 nm Resolution", ***Nanotechnology in press.***

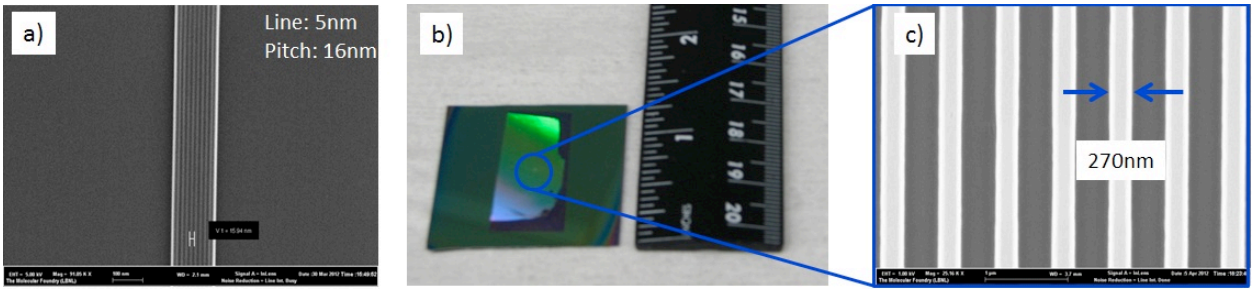

Figure 1. An example of the imprinted nanostructures onto TiO2 films: a) a Scanning Electron Microscope (SEM) image of a grating with 8 nm linewidth and 16 nm pitch before post imprint annealing; b) Optical micrograph of a 700 nm pitch grating imprinted onto TiO_2 films over 1 in^2 and c) a SEM picture of the grating.

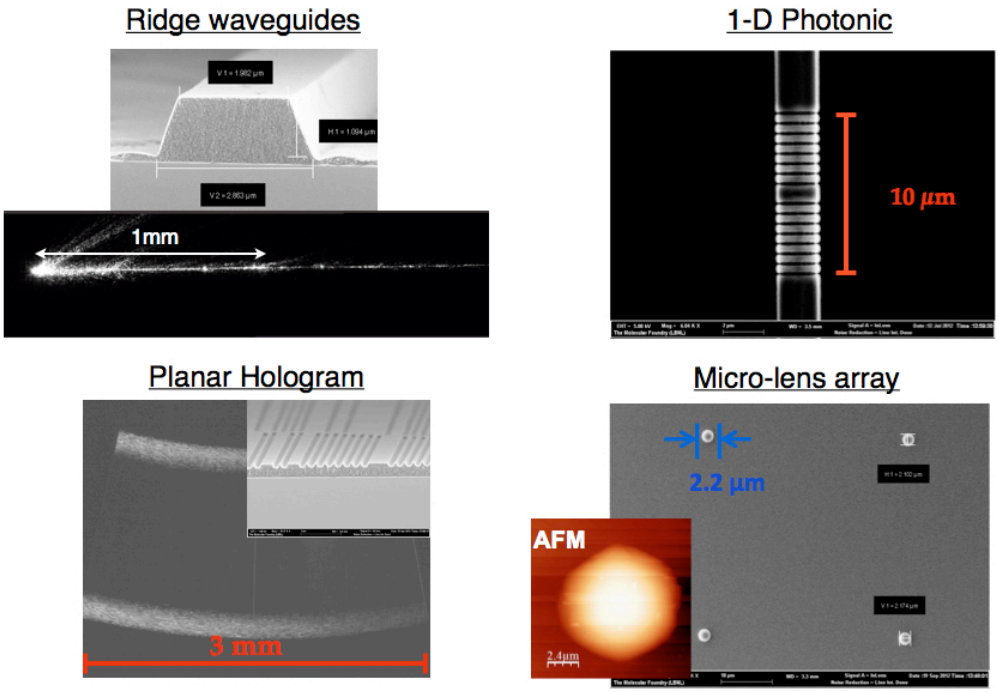

Figure 2: SEM pictures of the Imprinted Photonic Devices. The light propagation is shown for the ridge waveguide, and an Atomic Force Microscopy picture for micro-lens is presented.