Printable Integrated Photonic Devices with a high refractive index

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The development of photonic integrated circuits working in the visible light promises a revolution in a broad range of areas from bio-chemical sensing to quantum computing. Over the last years, novel nanophotonic structures and devices were demonstrated but are mainly limited to research laboratories due to their complex fabrication and very challenging scalability in large areas.

We present here a powerful route to fabricate the first printable photonic integrated circuits (PIC) with high refractive index. Our state-of-the-art process consists of direct patterning of novel hybrid functional materials by UV nanoimprint lithography at low pressure. Structures from sub-10 nm up to 10μm features sizes can be reproduced with high fidelity, and their optical properties can be easily tuned by post-annealing (Fig. 1) [1]. Planar lightwave circuits integrating a multimode ridge waveguide, light splitters and 100 channels on-chip demultiplexers (Fig 2) were successfully fabricated and their performance is in good agreement with the simulations [2]. We will also show that our technology is suitable for fabricating printable photonic crystal working in the visible light.

We believe that this work introduces a powerful and cost-effective route for the development of numerous nanophotonic structures and devices that will lead to the emergence of new applications.

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References:

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[2] C. Pina Hernandez, et al. “Printable planar lightwave circuits with a high refractive Index”, Nanotechnology 25 325302 (2014)

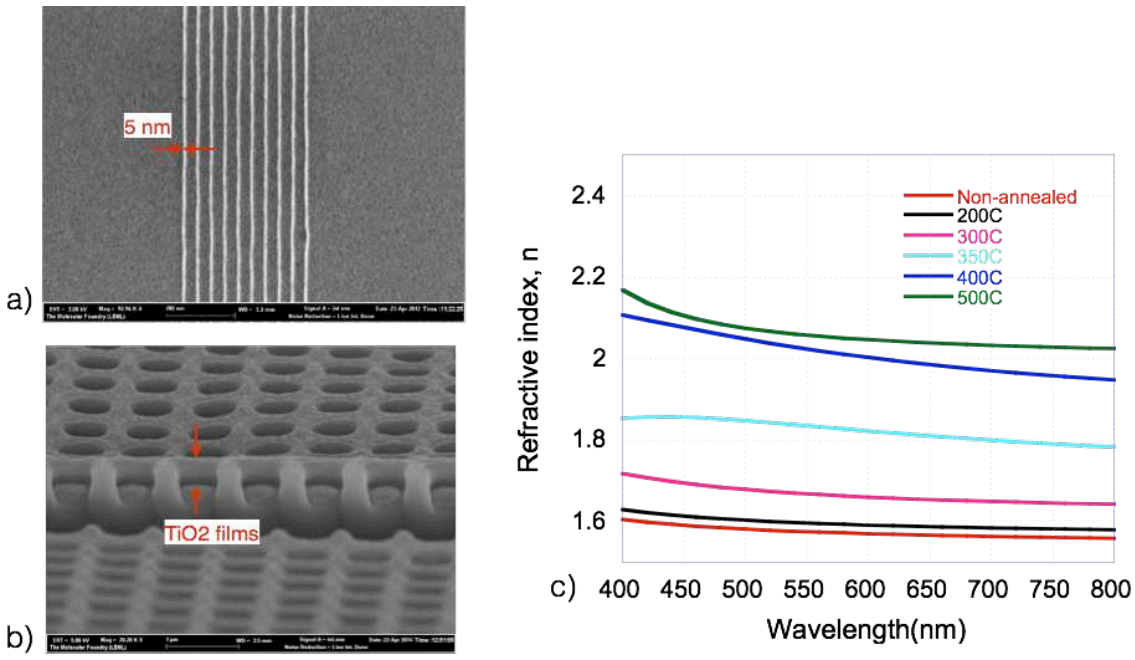

Figure 1: Scanning Electron Microscopy pictures of imprinted structures with refractive index n=2 @ λ=590nm. a) gratings with 40 nm pitch and 5 nm linewidth; b) photonic crystals. c) refractive index curve of optical films for different annealing temperatures.

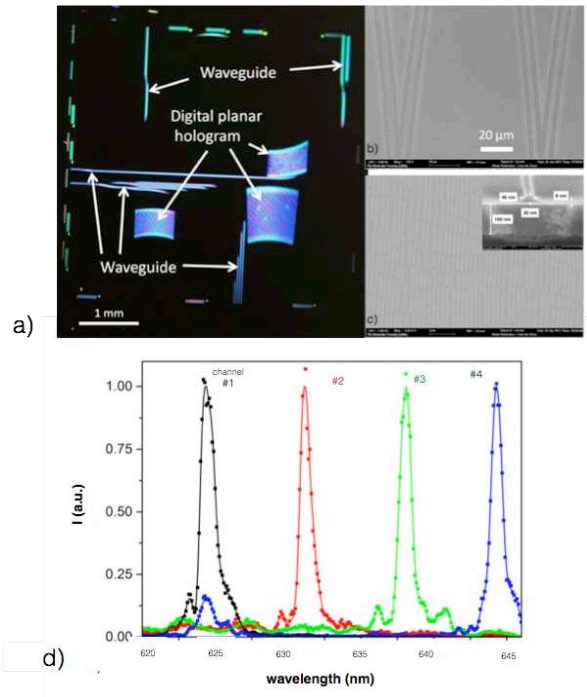

Figure 2: a) Optical top-view picture of an imprinted PLC chip. Scanning Electron Microscopy (SEM) pictures of (b) a light splitter and (c) a digital planar hologram; d) spectral response of 4 adjacents channels into a 100 channels DPH.