Digital Planar Holograms fabricated by Step and Repeat UV nanoimprint lithography

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Digital planar holography (DPH) is a unique approach for designing photonic devices with the desired properties to control light. Our technology is unique and enables new possibilities. Two first applications of DPH technology being developed are spectroscopy-on-chip [1] and high-brightness, high-power laser diodes. DPH patterns are calculated to encode the light (its wavelength) and to deflect the light to specific focal points (channels). The wavelength range out of a large spectrum can be specifically chosen and encoded in the design. High spectral resolution of 0.03 nm in the visible range of spectra was confirmed experimentally [2].

All DPH chips have been fabricated by expensive electron beam lithography. We demonstrate here for the first time the replication of digital holograms by UV Nanoimprint Lithography (UV-NIL) technology. Our novel Step&Repeat UV-NIL process on pre-spin coated resist films allows imprinting sub-15 nm patterns (Figure 1) with very high reproducibility [3]. The fine control of the residual layers thickness also allows an easy pattern transfer by plasma etching of some of the smallest feature sizes reported in the literature (Figure 2). The process has been successfully used to fabricate our nanophotonic DPH chips. Imprinted devices exhibit similar results to devices fabricated by electron beam lithography. Performance of imprinted DPH spectrometers will be presented (Figure 3). This work opens a route for low cost fabrication of new kinds of components based on DPH technology.

[1] S. Babin et al., Appl. Phys. Let., 95, 041105 (2009)

[2] C. Peroz et al., J. Vac. Sci. Technol B 27 3187 (2009)

[3] C. Peroz et al., Nanotechnology 21,445301 (2010)

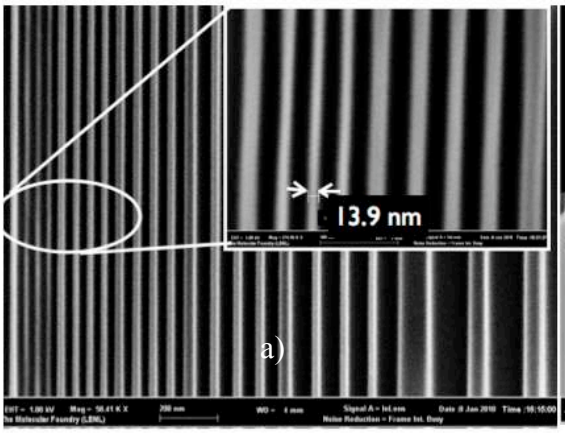

Figure 1.: Scanning Electron Microscope pictures of imprinted gratings with variable pitch and linewidth.

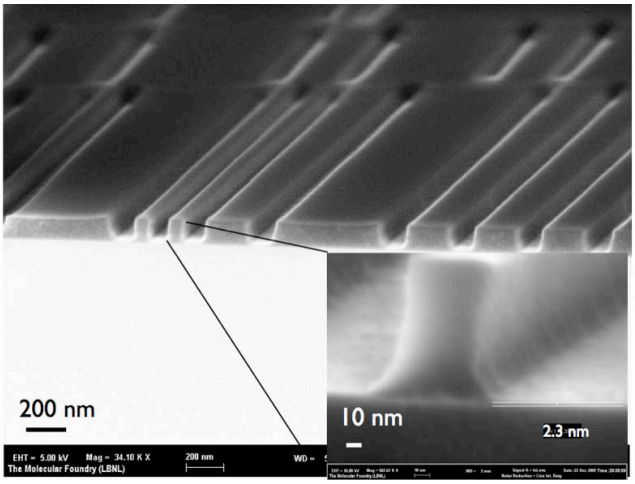

Figure 2.: SEM cross-section picture of a specific pattern with sub 3nm residual layer. The height of the pattern is around 105 nm.

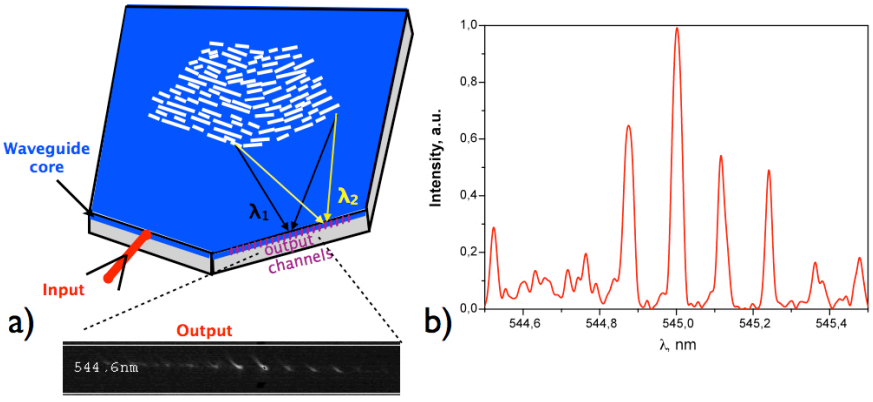

Figure 3.: a) Schematical view of DPH spectrometer chip and b) output light intensity distribution for an imprinted DPH chip. Channel spacing and pitch are equal to 0.2 nm and 20 µm, respectively.