UV-Nanoimprinting – A Potential Method for the Fabrication of 3D-Photonic Crystals

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This contribution presents results achieved in ultraviolet nanoimprint lithography (UV-NIL) recommending this process as a potential fabrication method for photonic crystals.

In photonic crystals the periodic arrangement of two materials with dissimilar dielectric properties exhibits a band of forbidden frequencies for the propagation of light (photonic band gap). Several techniques for the fabrication of 3D photonic crystals were proposed. Among them can be found wafer bonding, silicon micromachining, self-assembly, two-photon absorption, 3D holography as well as subsequent sputtering, DUV lithography and etching of consecutive planes.

UV-NIL offers a low cost opportunity for the fabrication of nm-scale pattern transfer in single or multiple step application if compared to mainstream optical lithography. In UV-NIL processes, soft (PDMS) or hard stamps (quartz glass) are used to imprint features into a UV-curable low viscosity material at room temperature. The Industrial Technology Roadmap for Semiconductors (ITRS) calls for nanoimprint lithography to be employed for the 32 nm node, which may be reached in 2010. This next generation lithography technique is using quartz glass stamps, fabricated by e-beam lithography and subsequent dry etching techniques, which can be repeatedly imprinted in spin-on material layers on silicon substrates.

A concept for the fabrication of the woodpile structure will be demonstrated as well as achieved results. The woodpile structure consists of aligned rods where every subsequent layer is rotated 90° above the former layer so that the fifth layer is exactly above the first one and the piles of the third shall be located exactly between the piles of the first row.