Silicon Double-Inversion of Polymeric Templates: A New Route Towards Three-Dimensional Photonic Bandgap Materials

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We present the successful silicon double-inversion of three-dimensional polymeric templates for Photonic Crystals. In a first step, the high-quality polymer template [1] is infiltrated via a room temperature silica chemical vapor deposition (CVD) process. Plasma etching and thermal combustion subsequently remove the original polymer template.

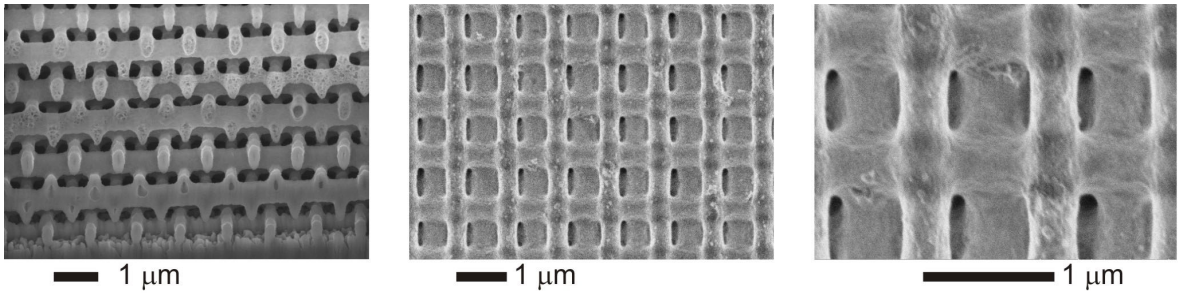

Fig. 1. SEM micrographs of the final silicon structure: (left) A cross section obtained with FIB slicing, clearly showing three-dimensionality of the final structure. Inhomogeneities are due to a slightly tilted slicing plane. (center) Top view of the silicon woodpile. The lattice period of the original template is well preserved. (right) Magnification of the surface. Note that even small features resulting from the resolution of the photoresist are well reproduced in our approach.

In a second step, the silica template is infiltrated with silicon via Si-CVD with disilane as a precursor. The silica backbone is finally removed by wet chemical etching, leaving behind a replica of the original polymer template cast in silicon (see Fig. 1). In combination with plasma treatment [2] of the original template, our method opens a facile way for the production of large-scale functional 3D Photonic Crystals at telecommunication wavelengths.

[1] M. Deubel et al., Nature Materials **3**, 444 (2004)
[2] G. von Freymann et al., Photonics and Nanostructures **2**, 191 (2004)