Fabrication of silicon inverse woodpile photonic crystals

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We fabricate silicon inverse woodpile photonic crystals for the first time. Our approach based on direct laser writing of polymeric templates and a novel silicon-single-inversion procedure leads to high-quality structures with gap/midgap ratios of 14.2 % centered at 2.5 µm wavelength. It is shown that gap/midgap ratios as large as 20.5 % centered at 1.55 µm might be experimentally possible in the near future.

Here, we modify the method of silicon-double-inversion [1] - used to replicate the original polymeric template with Si - to silicon-single-inversion [2], which results in its inverse structure: Rather than completely filling the polymer template with silica, we just provide a thin silica coating (Fig. 1, RHS). Next – without removing the polymer – we infiltrate the composite structure with Si *via* Si CVD. Amazingly, the thin silica coating provides sufficient and reliable stabilization for the high-temperature Si CVD process, in which the polymer melts but keeps its shape due to the silica coating. Finally, the silica is etched out and the polymer is calcined in air, leading to a Si inverse of the previously silica-coated polymeric template (Fig. 1, LHS).

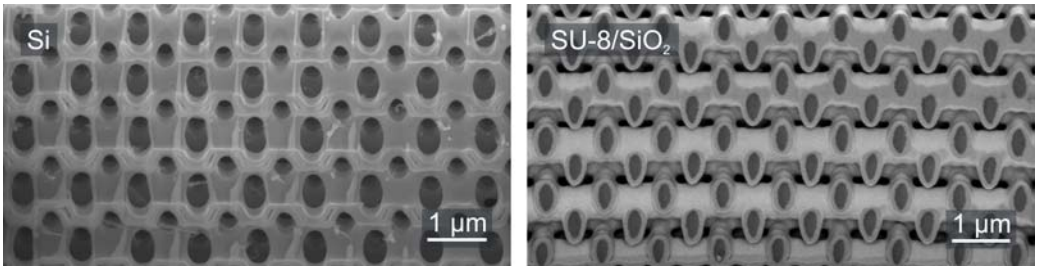

Fig. 1: Electron micrographs of a Si inverse woodpile (LHS) and a silica coated SU-8 woodpile after heating to the deposition temperature of Si (RHS).

[1] N. Tétreault, G. von Freymann, M. Deubel, M. Hermatschweiler, F. Pérez-Willard, S. John, M. Wegener, G. A. Ozin, *Advanced Materials*, **18**, 457 (2006).
[2] M. Hermatschweiler, A. Ledermann, G. A. Ozin, M. Wegener, and G. von Freymann, submitted (2006).