Direct Laser Writing of Three-Dimensional Photonic Crystals in High Index of Refraction Chalcogenide Glasses

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We present a two-step method for the direct fabrication of high index of refraction three-dimensional Photonic Crystals.

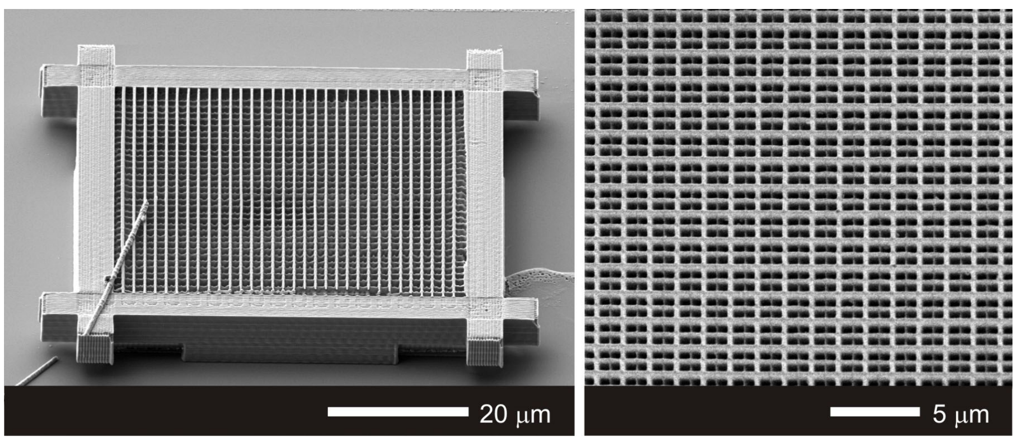

Fig. 1. SEM micrographs of a direct laser written As_2S_3 woodpile. On the left hand side the extremely high selectivity of our specially formulated wet etchant is clearly visible while the overall high definition of the structure can be seen on the right hand side. The rod spacing of this woodpile is 1.5 microns.

Direct laser writing [1] in arsenic-sulphur based thin films of chalcogenide glasses with intense 120fs pulses induces a local chemical phase change via two-photon absorption to As_2S_3. The inscribed three-dimensional Photonic Crystals are subsequently etched out with a specially formulated wet chemical etchant. The index of refraction of As_2S_3 (n = 2.45) is sufficiently high to open a complete band gap in diamond-like crystal structures, e.g., the woodpile structure, although further optimization of the writing process is required to achieve this goal. As our approach does not require any subsequent inversion with high index materials, it might provide a new route for the direct fabrication of functional Photonic Crystals.

[1] M. Deubel et al., *Nature Materials*, **3**, 444 (2004).