MICRONOVA
CENTRE FOR MICRO- AND NANOTECHNOLOGY
TKK – HELSINKI UNIVERSITY OF TECHNOLOGY

PHOTONIC CRYSTALS

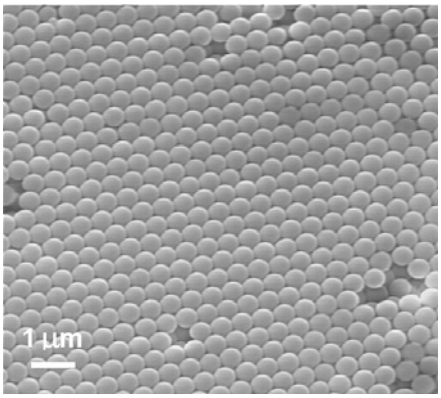
NANOTECHNOLOGY GROUP

OPTOELECTRONICS LABORATORY

Two-dimensional (2D) photonic crystals (PhCs) attract a lot of interest due to their exceptional ability to confine and guide light. Today, the photonic crystal research community faces two main bottlenecks: (a) there is still a gap between the theoretical predictions and the performances achieved by manufactured photonic crystals. Some work still needs to be done on the fabrication point of view in order to optimize the properties of photonic crystals in particular with respect to optical losses, (b) existing simulation tools for 3D photonic crystals and photonic crystal slabs are time and memory consuming. At the Optoelectronics Laboratory we are working on novel planar photonic crystal geometries with potential for low optical loss. We also developed a pseudo-vectorial approach to simulate thin photonic crystal slab in a more efficient and flexible way.

RECENT RESULTS:

The pseudo-vectorial approach was applied successfully to model the behaviour of opals fabricated from PMMA or polystyrene spheres. On the fabrication side, we are currently investigating theoretically and experimentally the properties of photonic crystals made of ring-shape holes. Manufacturing in silicon-on-insulator as well as end fire measurements are performed in collaboration with VTT.



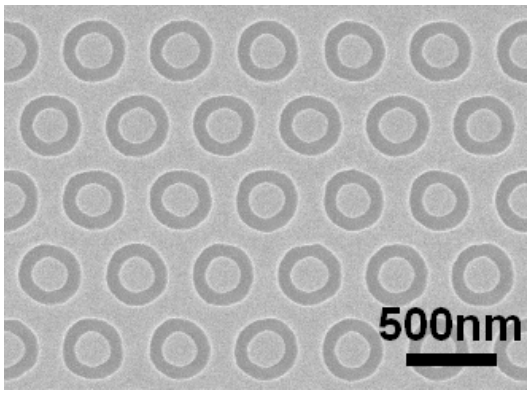


Figure: a) Opal made of polystyrene spheres arranged in an fcc lattice. *b) Planar photonic crystal with ring-shaped holes etched in silicon-on-insulator.*

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Recent Publications:

1. K. Varis, A.R. Baghai-Wadji, “Pseudo spectral analysis of radially-diagonalized Maxwell’s equations in cylindrical co-ordinates”, Aces Journal 20, n. 2, p. 1054 (2005).

2. K. Varis, M. Mattila, S. Arpiainen, J. Ahopelto, F. Jonsson, C.M. Sotomayor Torres, M. Egen, R. Zentel, “Reflection of focused beams from opal photonic crystals”, Opt. Express 13, n. 7, p. 2653 (2005).

3. M. Mulot, S. Arpiainen, A. Säynätjoki, H. Lipsanen, J. Ahopelto, “Photonic Crystal Slabs with Ring-Shaped Holes in a Triangular Lattice”, proceedings of the 7th ICTON Conference, July 3-7 2005, Barcelona, vol. 1, p. 155.

4. A. Säynätjoki, M. Mulot, S. Arpiainen, H. Lipsanen and J. Ahopelto, “Characterization of Photonic Crystal waveguides using Fabry-Pérot Resonanaces”, proceedings of the European Optical Society Meeting on Optical Microsystems, Capri, Sept. 15-18, 2005, p. 3.