NANOHOUR

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3:00 PM
Beckman Institute - Room 3269

Inorganic Photoresist Materials for Direct Fabrication of 3D Photonic Crystals Using Phase Mask Lithography

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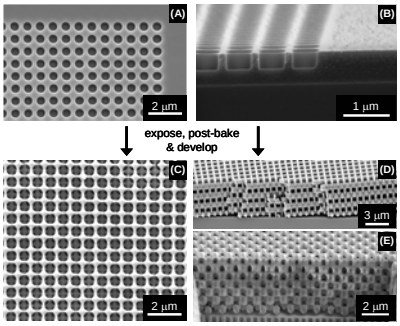
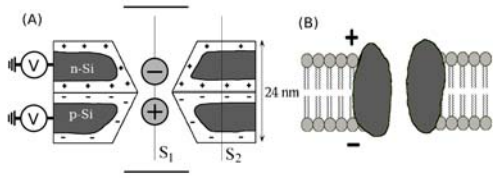
Graduate student in Materials Science and Engineering with Prof. Paul Braun



Embossed poly(methyl silsesquioxane) resist surface (A) and cross-section (B) after imprinting with 740nm pitch PDMS phase mask. The resist surface acts as the diffractive optical element allowing for its own 3D patterning: photonic crystal (001) plan view (C), cleaved (100) cross section (D), and Focused Ion Beam (110) cross section (E).

Direct fabrication of two- and three-dimensional inorganic photonic crystals has been achieved by using conformable phase mask elements to generate high contrast, 3D periodic interference patterns within two markedly different inorganic photoresists. Photonic crystals of varying lattice parameter and complexity were fabricated by varying the phase mask pitch and exposure wavelength and by utilizing both linear and 2-photon absorption. Photonic crystal structures were characterized via SEM and compared to the phase mask interference pattern predicted by RCWA and the Abbe Theory of image formation. The two inorganic photoresists, one oxide based and the other a chalcogenide glass, have competing strengths. The chemically amplified oxide resist is based on the acid catalyzed condensation of poly(methyl silsesquioxane) end groups. We have demonstrated the oxide resist's compatibility with nanoimprint interference lithography where the surface of the photoresist film is embossed to form the phase shifting element. After calcination, the silsesquioxane is thermally stable, allowing for infiltration with high index of refraction materials. The chalcogenide glass based photoresist is composed of As_2S_3. This material already has a high index of refraction, making further template infiltration and removal processing steps unnecessary. As_2S_3 is also highly nonlinear and shows excellent sensitivity to pulsed near-IR radiation, allowing us to directly pattern high quality photonic crystals from this chalcogenide glass using multiphoton interference lithography.



Simulation of Electrically Tunable Semiconductor Nanopores for Ion Current/Single Bio-Molecule Manipulation

Dr. Maria Gracheva

Post doctoral student with Prof. Jean-Pierre Leburton

We show that a semiconductor membrane made of two thin layers of opposite (n- and p-) doping can perform electrically tunable ion current rectification and filtering in a nanopore. Our model is based on the solution of the 3D Poisson equation for the electrostatic potential in a double-cone nanopore, combined with a transport model. It predicts that for appropriate biasing of the membrane-electrolyte system, transitions from ohmic behavior to sharp rectification with vanishing leakage current are achievable. Furthermore, ion current rectifying and filtering regimes of the nanopore correspond to different charge states in the p-n membrane which can be tuned with appropriate biasing of the n- and p- layers. More generally, the p-n membrane can be used for separation of charged species, controlled injection, release and blockade of charged molecules and ions, thereby mimicing in a very basic way the operation of voltage gated biological channels in cells. The p-n nanopore device also provides an opportunity to trap, stretch and effectively slow down DNA translocation in the pore, thus rising the resolution of the proposed nanopore sequencing device.

Coffee and cookies will be served.

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