3D Photonic Crystal structures for Sensing Applications

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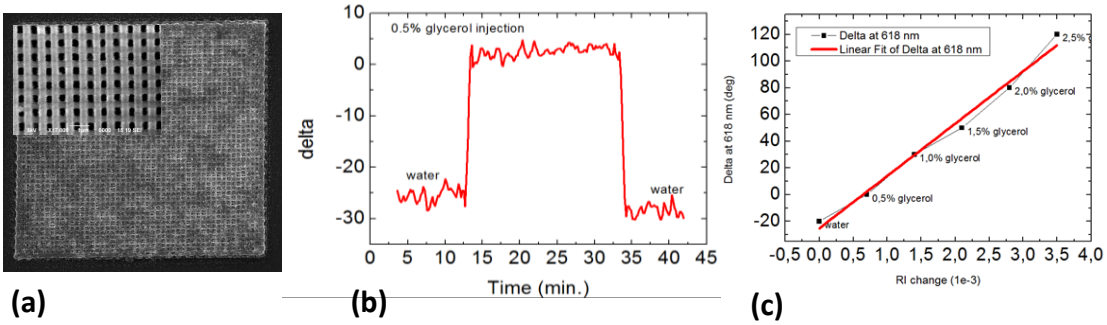
We present our research which focuses on the fabrication of 3D metallic Photonic Crystal (PhC) structures using Direct Laser Writing, for sensing applications. When a fs infrared laser is tightly focused into the volume of a photosensitive resin (which is transparent in the infrared), the laser pulses can cause multi-photon polymerization (MPP) and produce structures with sub-100nm resolution. We have made dielectric 3D nanostructures using a metal-binding organic-inorganic hybrid material. The PhC structure had the woodpile geometry with 700nm interlayer periodicity [1]. These structures were selectively covered with silver (Ag) using electroless plating [2,3]. The resulting metallic photonic nanostructure was applied as a phase-sensitive plasmonic biosensor, exhibiting sensitivity of $5x10^4$ deg. of phase shift per refractive index unit (RIU) . The optical properties were examined with the use of a Woollam M-2000 ellipsometer, which is based on measurements of phase-polarization properties of light reflected from the PhC structure, and sensing results were noticed.



(a) (b) (c)

Figures: (a) SEM image of the 3D PhC structure with 700nm interlayer periodicity; (b) Delta reflection data for the woodpile structure: response of phase Δ under the addition of 0.5% glycerine in water solution; (c) Delta as a function of the refractive index of the medium, as conditioned by different concentrations of glycerine: the resonant position linearly shifts under a relatively wide range of refractive index variations, measured sensitivity of $5x10^4$ deg. of phase shift per refractive index unit (RIU).

References:

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