

Description of the Exploratory Etching and Electrodeposition Project

CNF Project Number: 2527-17

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Primary CNF Tools Used: Oxford 82, Oxford 100, ASML, Gamma, PECVD, Cobra

Abstract:

This project is a continuing project. We will be finishing the fabrication of the hyperbolic metamaterial structure and designing a 2nd generation of the filter that uses more of a photonics crystal resonant material within a Bragg stack. Both the hyperbolic metamaterial structure and the 2nd generation devices have compelling properties. Both show very little dispersion — meaning that their performance is not affected by the angle of incidence to the optical signal.

Summary of Research:

During the last year, we have further designed the hyperbolic metamaterial device and have performed much more optimization and have taken into account practical design considerations. We are now fabricating the structure at the Cornell NanoScale Science and Technology Facility (CNF) at Cornell University.

We have developed a fabrication plan and are now implementing the plan, with masks designed and fabrication processes in development. Based on what we have learned, we are now investigating a 2nd generation device that does not use metal wires, but uses resonant cavities in the three middle layers of the Bragg stack. The resulting structure will have far less polarization dependence, will absorb less radiation, will be far easier to fabricate and manufacture, and will have a larger tuning range that allows for it to be used within pixelated wavelength filters for hyperspectral imaging applications.

We have been performing preliminary testing on the resonant cavities and have a preliminary design for operation in the midwavelength infrared range of 3-5 μm . The Bragg stack will use silicon and silicon dioxide, and potentially silicon nitride — all CMOS compatible devices — as well as having all structure features with sizes amenable to optical lithography.

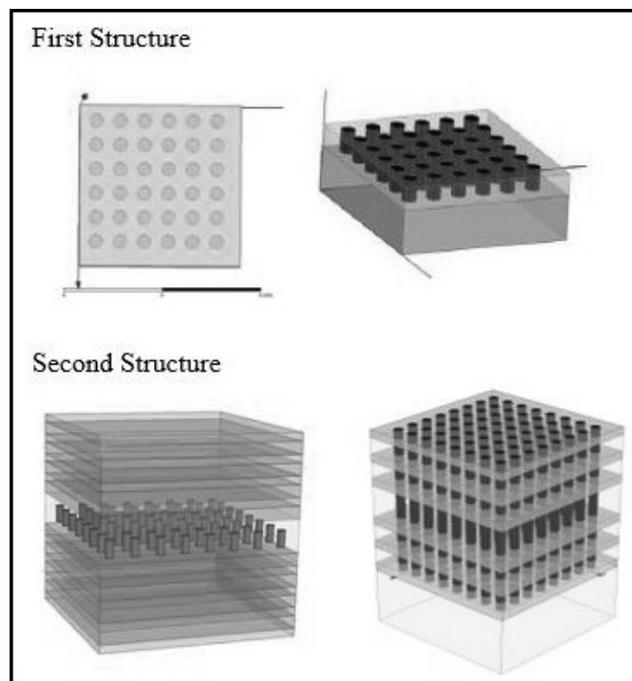


Figure 1: First Structure: The 1.5 μm SiO_2 film was deposited, patterned and etched. The holes were 0.5 μm , electroplated with Cu. Second Structure: Alternative layers of SiO_2 and Si are deposited, patterned and etched (all through the layers), then holes electroplated with Cu.

