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Large-Area Infrared Metamaterials using Interferometric Lithography[1]

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Large area (several cm^2) mid- and near-infrared metamaterial samples including analogs to split ring resonators and negative index materials have been fabricated using interferometric lithography and standard integrated circuit fabrication techniques. The split ring resonators are vertical structures with the smallest dimensions defined by deposition rather than by lithography. The negative index material is a Au-Al_2O_3-Au stack structure perforated with a 2D hole pattern. Both the amplitude and phase of the transmission and reflectivity are measured with phase-mask, zero-path-length difference, interferometric techniques and the refractive index is deduced by inverting these measurements. A rigorous coupled wave analysis (RCWA) is in excellent agreement with the measurement. Improvements in the original structure to provide a lower loss and an improved transmission for the structure are presented. Prospects for continued reduction in the loss and an improved figure of merit, $[|\mathrm{Re}(n)|/\mathrm{Im}(n)]$, are discussed. Interferometric lithography provides an inexpensive, facile, large-area technology for the fabrication of visible/infrared metamaterials with a 2D array patterning capability extending to as small as 30-nm features.

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