# Fabrication of Semiconductor-Metal Optical Fiber Metamaterials for Electromagnetic Devices

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We report incorporating semiconductors and metals into microstructured optical fibers (J. C. Knight, *Nature* **424**, 847, 2003) via a high pressure deposition process such that they can be exploited for electromagnetic devices. The process can easily be extended to allow for deposition of a broad range of crystalline semiconducting, insulating, and metallic materials, allowing ordered arrays of wires of such materials to be spatially organized inside optical fibers. The figure, for example, shows a cross section of an array of ~2 μm diameter six-sided silicon tubes deposited within the confines of a large air fraction "honeycomb" microstructured optical fiber. It is remarkable that the high pressure process is so well behaved that it proceeded until the holes from which deposition occurs close down to even sub 10 nm dimensions. Even 100 nm and smaller microstructured optical fiber holes can be filled with semiconductors and metals over lengths of many centimeters, allowing for high index contrast metamaterials at dimensions down to the nanoscale. It is thus now possible to incorporate metals and crystalline semiconductor dielectrics into complex fiber structures for a broad range of frequency selective, antenna, IR and optical applications. This technology is particularly appealing for its potential applications in the area of e-textiles and on-body communication systems. Finally, a brief discussion will also be presented on the computational electromagnetic modeling tools and optimization techniques that are being developed for the analysis and design of this new class of complex metamaterial structures.