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Embeddable Metal Coil Microparticles for 3-D Metamaterial Applications C. K. HARNETT, E. V. MOISEEVA, Y. M. SENOUSY, University of Louisville — We will discuss our recent efforts in strain-based self-assembly of metal/insulator bilayers for production of freestanding metal coil microparticles in the sub-200 micron diameter range. This process has generated microparticles having metal coils in three orthogonal planes, demonstrating a possible route to polarization-insensitive metamaterials. Other designs such as "Swiss roll" shapes, coils in only one or two planes, or coils in non-orthogonal planes are also achievable by this method. Because the coils are assembled out-of-plane using strain mismatch between two thin films, particle diameter is governed mainly by film thickness, rather than by lithographic patterning as in planar split-ring resonators. These microparticles may be detached from the substrate by etching. Assortments of particles may function as taggants with an engineered spectral signature in the microwave to terahertz range. Surprisingly, such particles are robust enough to be embedded and detached into a flexible polymer cast over the substrate. Detaching entire arrays preserves particle orientation and any spatial gradients designed into the array. Stacking arrays of embedded resonant particles, or distributing freestanding particles uniformly throughout a dielectric matrix, will enable production of machinable, three-dimensional electromagnetic metamaterials.

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