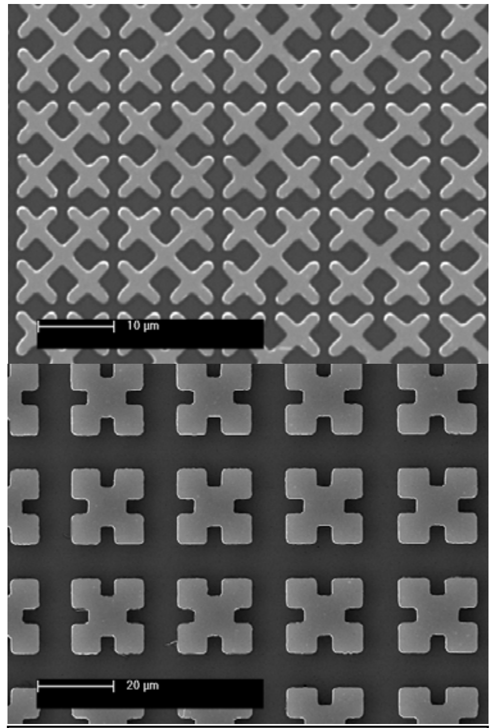
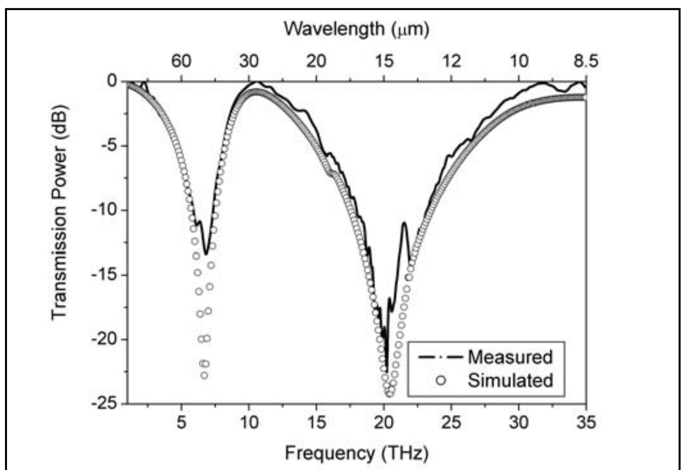
There is currently interest in developing materials that exhibit variable reflection and other filtering charactereistics in the visible to near-infrared wavelengths. While multilayer dielectric mirrors can be designed for narrowband reflection over a small range of wavelengths within the visible and near-infrared, it is not possible to achieve multiband reflection using these structures. Moreover, the reflectivity of these dielectric mirrors is generally limited to radiation of normal to near-normal incidence, as opposed to highly attractive omnidirectional reflectivity. Finally, to achieve good optical quality (i.e., > 95% reflection) one must deposit many layers of material (i.e., > 10 periods) with excellent uniformity and reproducability; this is both time consuming and costly.



SEM images of fabricated fractal cross-dipole (top) and fractal square patch (bottom) metallic patch arrays.

Metallodielectric structures consisting of many layers have been demonstrated as infrared filters with multiple stopbands or passbands. By using self-similar fractal metallic patch structures, we have developed a single layer metallodielectric surface with strong multiple stopbands (high reflection). The spectral response of the surface is optimized using a full-wave Periodic Method of Moments code to choose the best metallic patch geometries. Design flexibility allows the choice of a response that is sensitive or insensitive to both angle of incidence and wave polarization. Stopbands in the far-infrared have been achieved using a standard photolithography process, while the response could easily be scaled to the mid- and near-infrared using alternative lithography techniques, such as nanoimprint lithography.



Comparison of the measured transmission spectrum for a fractal cross-dipole array to the response predicted by the PMM model with dielectric and metallic losses included. The measured stopbands are -13.4dB at 44μm and -22.5dB at 15μm.

Alternative metallic patch geometries are being explored using a genetic algorithm modeling process that provides enhanced design flexibility and the ability to optimize over many parameters simultaneously. The genetic algorithm is also being used to demonstrate theoretically the broad tunability of a single layer metallodielectric grid with switching elements placed periodically across the grid.