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Title:Engineering the properties of terahertz filters using multilayer aperture arrays
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Abstract:We experimentally demonstrate the ability to create additional transmission resonances in a double-layer aperture array by varying the interlayer gap spacing. In the case of periodic aperture arrays, these additional resonances are sharply peaked, while for random aperture arrays the resonances are broad. Surprisingly, these additional resonances only occur when the interlayer gap spacing is greater than half the aperture spacing on a single array. Since there is no corresponding periodicity in the random arrays, these resonances occur regardless of how small the gap spacing is made. This phenomenon can be accurately modeled only if the correct frequency-dependent complex dielectric function of a metal film perforated with subwavelength apertures is used. Using THz time-domain spectroscopy, we are able to directly obtain the complex dielectric response function from the THz experimental transmission measurements. We conclude by demonstrating several passive free-space THz filters using multilayer aperture arrays. Importantly, we show that the magnitude of the lowest order resonance can be approximately maintained, while the background transmission can be significantly suppressed leading to a significant improvement in the optical filter fidelity.
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