Measurements of an Antenna Inside Low Index Metamaterial Over a Conducting Plane

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Interest in low or zero refractive index media has grown since the first demonstration of negative index material. Radiation originating inside a very low index medium, either positive or negative, would be refracted along the normal axis when exiting, effectively brightening the source. Our previous work demonstrated a ring and post type metamaterial with index approaching zero near 14 GHz, measured by a Snell's Law prism experiment (B. W. Turchinetz et al., "Experimental use of metamaterial as a collimator," Proc. of the 2005 Antenna Applications Symposium at Allerton, IL). That work also showed the effect of inserting a narrow dipole in a block of the material. The far-field azimuthal pattern of the antenna was converted from omnidirectional to bidirectional. The peak power was nearly doubled compared to the value in air, with a 3dB beam width of 28 degrees. Measurements were also made with a reflector behind the block. The peak power was increased, though not doubled. The difference could be due to either absorptive losses or destructive interference. It is the goal of this new work to investigate further the use of a reflector behind a low index metamaterial block. The separation of the source from the reflector at the back of the block was decreased in steps of one unit cell. The unit cell "granularity" and associated anisotropy are significant limitations of current metamaterials. Clear interference nulls were observed for certain separations. The plot below shows the pattern of the antenna in air, and inside the block with and without a reflector.