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Permittivity and Permeability in Double Positive Metamaterials Fabricated with Barium Titanate

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Emerging dielectric materials have been utilized to reduce the size of antennas and advanced pulsed power systems. Metamaterial composites can replace these traditional dielectrics by providing better electromagnetic properties while also being easy to machine into complex shapes. We are presently investigating these metamaterial composites, which have an impedance that can operate at the impedance of free space or even lower and believe that the metamaterials will further reduce the size and volume of advanced systems. Previous work done at the University of Missouri has tested a chemical process to develop a metamaterial with a ferromagnetic core surrounded by a matrix of barium titanate. Using this chemical method while adjusting the precursors in the reaction based on particle characteristics, can allow the amount of barium titanate on the particles to be tailored for the desired permittivity. The permittivity and permeability of the material is measured with a coaxial airline and an Agilent Network Analyzer. Multiple composite materials with increasing layers of barium titanate were synthesized and tested to evaluate the permittivity and permeability and the impedance versus frequency calculated. The results of breakdown measurements will also be discussed.
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Primary author: NOEL, Kelli (University of Missouri)

Co-authors: Mr HOWARD, Grant (University of Missouri); Dr CURRY, Randy (University of Missouri)

Presenter: NOEL, Kelli (University of Missouri)

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