Abstract

Novel Left-Handed Material Based on a Network of Plasma Channels

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Received: Thu, 28 Feb 2002 06:57:59

Left-handed materials (LHM) have the unusual property of having negative magnetic permittivity $\mu < 0$ and dielectric constant $\epsilon < 0$. Due to their counter-intuitive refractive properties, LHMs have been recently proposed for making novel lenses. While LHMs do not occur in nature, they can be designed from naturally occurring building blocks. We present the results of numerical and analytic modeling of such a medium. The new composite medium is periodic in two dimensions, and consists of two materials with different dielectric constants, $\epsilon_1 > 0$ and $\epsilon_2 < 0$. Conceptually, this medium can be thought of as the periodic network of plasma channels. This periodic structure is conceptually simple and does not involve the complicated split ring resonators which were employed for constructing the LHM in the microwave range. Therefore, the proposed composite material shows the path to extending LHMs to terahertz or optical frequency bands. Depending on the desired frequency, the plasma-like medium can be composed of a phonon-polariton material (e.g., LiTaO3) or thin wires. We present the mean-field description of the thin-wire meshes in two and three dimensions.

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