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MICROWARE APPLICATIONS OF NEGATIVE-REFRACTION METAMATERIALS

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Metamaterials make a wide class of artificial composites, characterized by features that are hardly achievable technologically and unattainable in nature materials. These features, such as negative group velocity of EM wave and thus refraction index, are obtained due to simultaneously negative effective permittivity and permeability. The major classes of these composites are single negative materials (SNG), double negative materials (DNG), and electronic bandgap materials (EBG) or photonic crystals [1]. Permittivity and permeability depend on frequency, so there are RF MTMs (including microwave), terahertz, optical etc.

When constructing the MTM it is important to follow general observation: the unconventional electromagnetic properties of MTMs are exhibited when these materials are paired with other materials with at least one oppositely signed constitutive parameter [1].

The first and the most known DNG structure for high frequencies is combination of thin metallic wires and split ring resonators. Other wide-known structures are transmission line MTMs and Swiss rolls, which demonstrate unconventional properties at low frequencies as well [1].

A huge potential of MTM structures is embodied in various kinds of DNG materials-containing waveguides, power splitters, phase shifters, filters, couples, cavity resonators. The salient example are leaky-wave antennas, which must operate in higher order mode in a conventional case. In order to achieve more efficient and simpler feeding of antennas a CRLH transmission line is applied [2].

1. Metamaterials: Physics and Engineering Explorations / Ed. by N. Engheta, R.W. Ziolkowski. IEEE Press, A John Wiley & Sons, Inc., 2006. 414 p.