Experimental radiophysics of magnetic enantiomorphous (gyrotropic, optically active, chiral) metamaterials in microwave band

Responsible: Ph. D. Polevoy S.Yu., Cor. member of NASU Tarapov S.I.

Main results:

The experimental setup (Fig. 1) for the study of gyrotropic metamaterials (Fig. 2) with magnetization along the direction of electromagnetic wave propagation in the frequency range 22-40 GHz [1-3] is designed.

Fig. 1. Experimental setup for gyrotropic metamaterials study

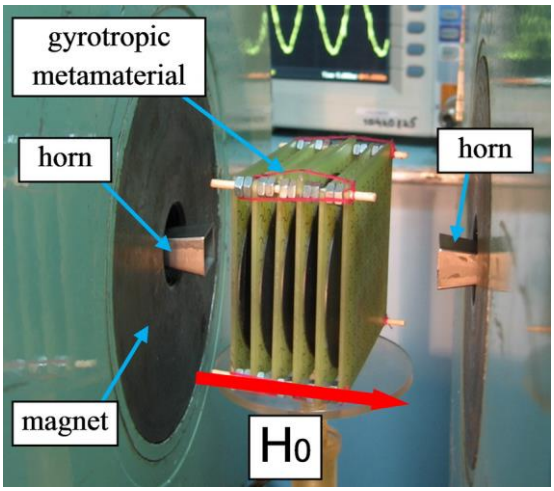

Fig. 2. Gyrotropic metamaterial with longitudinal magnetization

The algorithm of design of enantiomorphous (optically active, chiral) media with predetermined constitutive parameters: permittivity, permeability and chirality in the microwave range is developed experimentally, theoretically and numerically. Also an inverse problem – the measuring the above mentioned three parameters is solved.

Besides:

1. The possibility of the Faraday effect enhancement for longitudinally magnetized gyrotropic metamaterial (Fig. 3) is demonstrated experimentally [2].
2. It is shown both theoretically and experimentally that for normal incidence of electromagnetic waves the forbidden bands boundaries of periodically layered chiral medium (Fig. 4) depend only on the permittivity and permeability of layers [4].
3. The "left-handed" mode with a negative dispersion for chiral layered structure (Fig. 4) is detected [5].

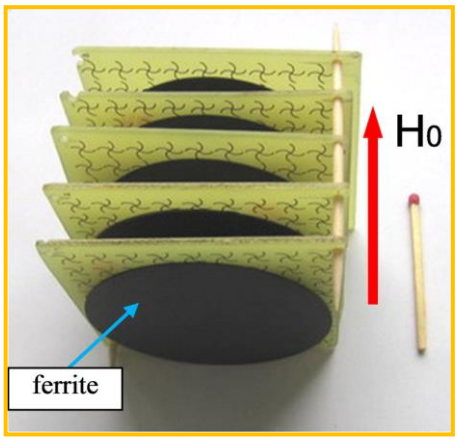

Fig.3. Nonreciprocal chiral metamaterial

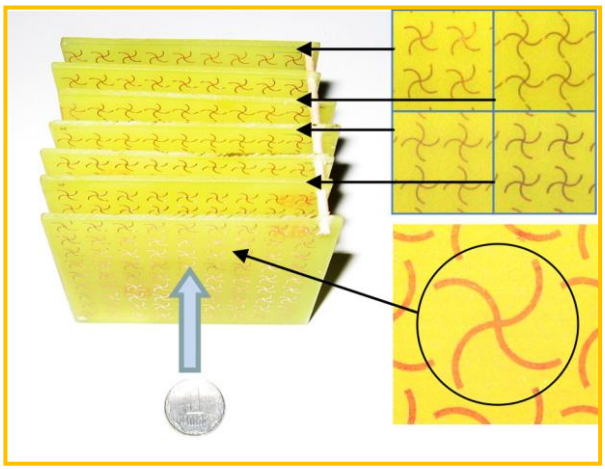

Fig.4. Reciprocal chiral metamaterial

A detailed information about the results is given in

References:

1. Girich A.A., Polevoy S.Y., Tarapov S.I. et.al., Experimental Study of the Faraday Effect in 1D-Photonic Crystal in Millimeter Waveband, Solid State Phenomena, 2012, V. 190, P. 365-368.
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3. Polevoy S.Yu., An experimental technique for estimating constitutive parameters of chiral media in the millimeter wavelength range, Telecomm. and Radio Eng., 2014, V.73, N8, P.681-693.
4. Beletskii N.N., Polevoy S.Y., Tarapov S.I., Electromagnetic wave propagation in the finite periodically layered chiral medium, Progress In Electromagn. Research M, 2014, V.38, P.185-192.
5. Tarapov S.I., Polevoy S.Yu., Beletski N.N., Gyrotropic Metamaterials and Polarization Experiment in the Millimeter Waveband, chapter in "Contemporary Optoelectronics: Materials, Metamaterials and Device Applications", Editors: O. Shulika and I. Sukhoivanov, Springer Series in Optical Sciences, Vol. 199, pp. 115-129, 2015.