DIFRACTION OF ELECTROMAGNETIC WAVE ON INFINITE CYLINDER WITH METAMATERIAL COATING

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The last time researches of metamaterials prove their actuality for new microwave and optical devices development [1]. Due to unique physical properties of these materials the possibilities for realization qualitatively new operating characteristics of different functional devices that cardinally different from well-known ones are opened. On the basis of metamaterials applications the methods for disguise of objects (cloaking), forming of the focusing elements with unusual properties, waveguides and high-Q resonators are being created [2]. Metamaterials application for forming different cylinders coating is presently examined as a perspective method of the control of scattering field characteristics and is one of the most intensively developed directions of experimental and theoretical investigations [3].

In this paper a task about interaction of plane monochromatic wave with a metallic or dielectric cylinder with a coating the material parameters of that can have both positive and negative values is considered. Implied, that the negative values of permittivity and permeability correspond to the negative refraction index of metamaterial. Basic attention was paid to development of the methods for the field distribution visualization inside the cylinder coating and in area of nearby space.

Representations for the coordinate electromagnetic field components by the series of cylindrical functions were used for the problem solving. As a result the system of algebraic equations for unknown amplitude coefficients determination was obtained. The system was solved by means of computer algebra package MathCAD on the basis of Cramer's rule application.

The developed calculation project allows investigating the spatial distribution of all co-ordinate components of the electromagnetic field, scattered by infinite cylinder with a coating that can have both positive and negative index of refraction. Basic regularities of the effect of cylinder material parameters, it's coating and geometrical sizes on the amplitude distribution of electric field are defined. It is shown that a metamaterial coating provides focusing of incident radiation inside a structure for cases when a cylinder is both metallic and dielectric. The obtained results can be applied for investigation of new kinds of cylindrical lenses and forming of the high-Q resonant systems with the metamaterial components.

[1] Li C., Shen Z. "Electromagnetic scattering by a conducting cylinder coated with metamaterials", *Progress in electromagnetics research*, pp. 91-105, 2003.
[2] Wu Q., Zhang K., Meng F.-Y., Li L.-W. "Electromagnetic characteristics of metamaterial cloak covered dielectric cylinder illuminated by electric line source", *IET Microwaves, Antennas&Propagation*, vol. 4, Iss.10, pp. 1680-1688, 2010.
[3] Kil'dyshev A.V., Shalayev V.M. "Transformatsionnaya optika i metamaterialy", *Uspekhi fizicheskikh nauk,* vol. 181, no.1, pp. 59-70, 2011.