ABSTRACT

" Guaranteed Convergence Algorithms for electromagnetic modeling of Cylindrical Luneburg Lens with Conformal Graphene Strip "

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We will consider the radiation characteristics, in two orthogonal polarization regimes, of THz antenna made of circular layered dielectric rod, which mimics the Luneburg Lens [1-3], decorated with conformal graphene strip. The strip has arbitrary angular size and location (Fig.1).

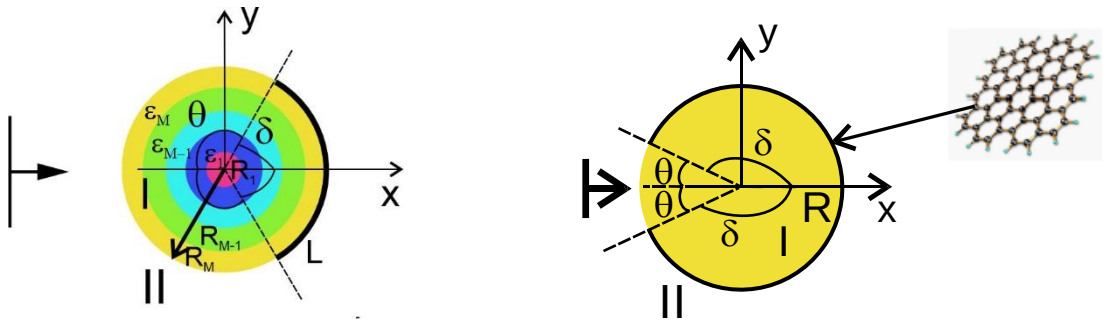

Fig. Cross section of the discrete Luneburg lens antenna (left) and uniform circular dielectric rod (right) decorated with a conformal strip of graphene

In the first case, the plane E-polarized time-harmonic ($e^{-i\omega t}$) wave scattering by a lossless circular dielectric cylinder, the outer boundary of which is partially covered with a conformal strip of graphene was considered. In the core of our treatment, there is a dual series equation where the unknown is the Fourier harmonicas. We solve this equation using the Inverse Discrete Fourier Transform method. It enables to obtain an infinite set of linear algebraic equations having the Fredholm form of the second kind. Due to this, Fredholm theorems imply convergence of the numerical algorithm. This guarantees the convergence of the obtained results [1-2].

In the second case, the plane H-polarized time-harmonic ($e^{-i\omega t}$) wave scattering was considered. Here, it is worth noting that in the case of the H-polarization the dual series equation for the amplitudes of the Fourier harmonics has the behavior that the static part of obtained equation forms the Riemann-Hilbert Problem on an arc of the unit circle on the complex plane. Therefore, the problem was treated by the method based on the method of analytical regularization and uses explicit inversion of the static part of the problem (i.e. its most singular part). The resulting infinite-matrix equation is a Fredholm second kind equation too. This guarantees the convergence in the sense that the larger the matrix truncation order, the closer the solution to exact one, in a certain norm [3].

We have built the algorithms able to provide accurate modeling of the scattering, focusing ad radiation characteristics of quasioptical-size cylindrical discrete Luneburg lens antenna, decorated with a sub-wavelength-size conformal strip of graphene. These algorithms outperforms commercial codes in speed and accuracy.

References

[1] I.O. Mikhailikova, S.V. Dukhopelnykov, "2-D scattering and absorption of E-polarized plane wave by a circular dielectric wire with partial graphene cover," *Proc. European Microwave Conf.* (EuMC-2022), Milan, 2022, pp. 290-293.

[2] I.O. Mikhailikova, S.V. Dukhopelnykov, Ronan Sauleau " Non-plasmon resonances in the E-polarized plane wave scattering and absorption by a circular dielectric wire with partial graphene cover," *Proc. Int. Conf. Electronics and Nanotechnology* (ELNANO-2022), Kyiv, 2022, pp. 160-163.

[3] I.O. Mikhailikova, S.V. Dukhopelnykov, "MAR Algorithm for Cylindrical Luneburg Lens Equipped with Conformal Graphene Strip," *Proc. European Conf. on Antennas and Propagation* (EuCAP 2023), 2023. (accepted for presentation at Convened Session "Advances in and Applications of the Methods of Analytical Regularization in Electromagnetics" at EuCAP 2023)