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Subwavelength terahertz imaging with graphene hyperlens

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The terahertz (THz) technology provides with striking possibilities for defense, spectroscopy and biomedical imaging [1]. However, a large wavelength (λ > 10 μm) does not allow resolving tiny details. One of the solutions is a lens consisting of a material with the hyperbolic dispersion (hyperlens) [2]. Direct scaling of optical designs to the THz range is not possible, since metal's negative permittivity becomes too large in absolute value. This is why the employment of new materials is required.

In this contribution we report for the first time the graphene wire medium based hyperlens. Stacking multiple structured graphene layers provides the hyperbolic dispersion. To restore the graphene wire medium dispersion diagrams and isofrequency contours we developed a rigorous numerical method. It also gives the possibility to calculate the permittivity tensor and to check the applicability of the homogeneous medium approach.

Our numerical simulations in COMSOL and CST Microwave Studio confirm the subwavelength imaging properties of the graphene hyperlens. An example of magnification of two point sources separated by $\lambda/5$ to the size of few wavelength, which then can be detected with conventional optics, at frequency f = 6 THz (λ=50 μm) is shown in the **Fig. 1**. The details of the graphene hyperlens design as well as the dispersion diagram calculation method will be provided during the presentation.

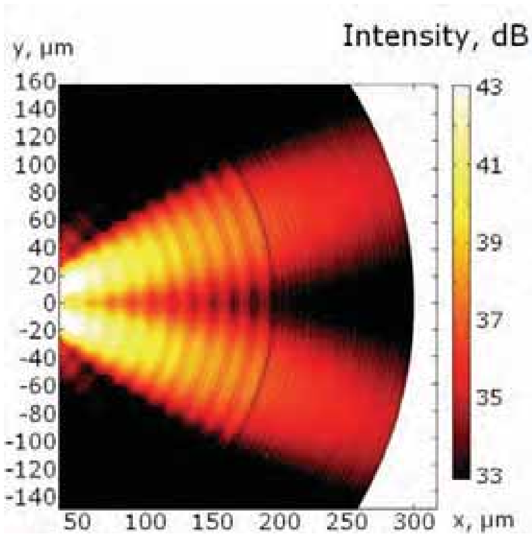

Fig. 1: Graphene hyperlens in action. Two point sources separated by $\lambda/5$ = 10 μm are magnified to the distance of a few wavelengths.

[1] P. U. Jepsen, D. G. Cooke, and M. Koch, *Laser & Photon. Rev.* **5**, 124-166 (2011).
[2] Z. Jacob, L. V. Alekseyev, and E. Narimanov, *Opt. Express* **14**, 8247-56 (2006).