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Engineering of plasmonic anisotropic nanopatch-based metasurfaces

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Hyperbolic metasurfaces are known for their dispersion and polarization properties, such as negative refraction, hyperlensing, enhanced spontaneous emission, etc [1]. The surface waves localized at hyperbolic metasurfaces are called hyperbolic plasmon-polaritons and exhibit a lot of potential applications for planar technologies [2].

In this work, we analyze the dependencies of the spectral positions of the resonances and spectral bandwidth of hyperbolic regime for the metasurfaces based on square arrays of the nanodisks [3] and rectangular nanopatches [4]. Namely, we study the resonant characteristics of metasurfaces by varying the size of the nanoparticles, the degree of stretching (anisotropy) and the period of the metasurface from the isotropic to extreme anisotropic cases.

Surface plasmons typically propagate radially in all directions, losing a significant portion of their energy during the directional signal transferring. Typical values of the signal amplitude reaching the receiver usually do not exceed 0.1% of the signal amplitude at the source output, and this significantly limits the use of surface plasmons in practical applications. To solve this problem, we demonstrate the one special regime as plasmon canalization, which is characterized by a flat isofrequency contour and the self-collimated unidirectional propagation of surface wave. In this case, the signal transmission efficiency is close to the maximum, that is, the signal amplitude at the source output and at the receiver input are approximately the same, which makes it possible to ensure highly efficient signal transmission with minimal losses. The canalization takes place in the vicinity of one of the resonances highlighting the relevance of the metasurface engineering for the in-plane optical signal transferring.

[1] O. Takayama, and A. V. Lavrinenko, J. Opt. Soc. Am. B: Opt. Phys. 36(8), 38–48 (2019).
[2] J. S. Gomez-Diaz, and A. Alu, ACS Photonics 3(12), 2211–2224 (2016).
[3] A. Hrinchenko, and O. Yermakov, J. Phys. D: Appl. Phys. 56(46), 465105 (2023).
[4] A. Hrinchenko, S. Polevoy, O. Demianyk, and O. Yermakov, J. Appl. Phys. 135(22), 223102 (2024).

Primary authors: HRINCHENKO, Artem (V. N. Karazin Kharkiv National University); DEMIANYK, Oleh (V. N. Karazin Kharkiv National University); POLEVOY, Sergey (O. Ya. Usikov Institute for Radiophysics and Electronics NASU); YERMAKOV, Oleh (V. N. Karazin Kharkiv National University, Kharkiv, Ukraine / Leibniz Institute of Photonic Technology, Jena, Germany)

Presenter: HRINCHENKO, Artem (V. N. Karazin Kharkiv National University)

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