Nanoimaging and manipulation of polaritons in graphene and boron nitride

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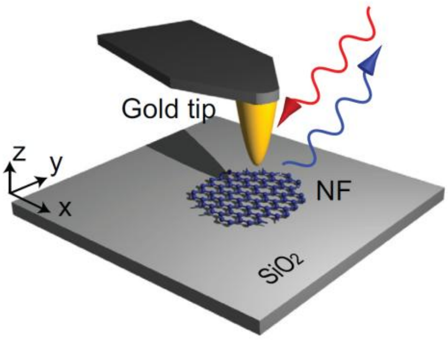
Abstract

A promising solution for active control of light on the nanometer scale are plasmons in graphene, which offer ultra-short wavelengths, long lifetimes, strong field confinement, and tuning possibilities by electrical gating. Here, we apply scattering-type scanning near-field optical microscopy (s-SNOM) for real-space imaging of plasmons [1-3] in tailored disk and rectangular graphene nanoresonators [4] at mid-infrared frequencies. The near-field images exhibit intriguing patterns and features, indicating the interference of manifold plasmon excitations. A simple model well reproduces the two-dimensional experimental patterns, allowing us for identifying edge and sheet modes, as well as for separating them either spatially or in energy. We anticipate that real-space analysis of graphene plasmons could be of great benefit for the development and quality control of emerging graphene plasmonic technologies, particularly when novel design concepts and 2D material heterostructures have to be tested and verified. As another application of s-SNOM we discuss its combination with time-domain interferometry, which allowed for visualizing in time and space the propagation of hyperbolic phonon polaritons in boron nitride slabs, revealing negative phase velocity and group velocities as small as 0.002c [5].

References

[1] J. Chen, et al., Nature **487**, 77 (2012)
[2] Z. Fei, et al., Nature **487**, 82 (2012)
[3] P. Alonso-González, et al., Science **344**, 1369 (2014)
[4] A.Y. Nikitin, et al., submitted
[5] E. Yoxall, Nat. Photon. **9**, 674 (2015)

Figures



Near-field imaging of plasmonic graphene disk resonators