Two Dimensional Nanooptics with Graphene Plasmons

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Abstract
Forthcoming information and communication technologies demand the manipulation of not only electrons but also optical fields at the nanoscale. A promising solution for an active control of light in such small regions is the excitation and manipulation of graphene plasmons, which offer ultra-short wavelengths, long lifetimes, strong field confinement, and tuning possibilities by electrical gating. The huge momentum mismatch between graphene plasmons and photons, however, presents a major technological challenge [1]. Here, I will present a versatile platform technology that, based on resonant optical antenna structures (Fig. 1), allows for an efficient coupling of incoming light into propagating graphene plasmons. More importantly, I will show that these antennas and the use of spatial conductivity patterns (e.g. double layer graphene patches) also allow for controlling the graphene plasmons wavefronts [2], constituting an essential step for the development of graphene plasmonic circuits.

References
[1] J. Chen, et.al. *Nature* **487**, pp77-81 (2012).
[2] P.Alonso-González, et. al. *Science* **344**, 1369 (2014).

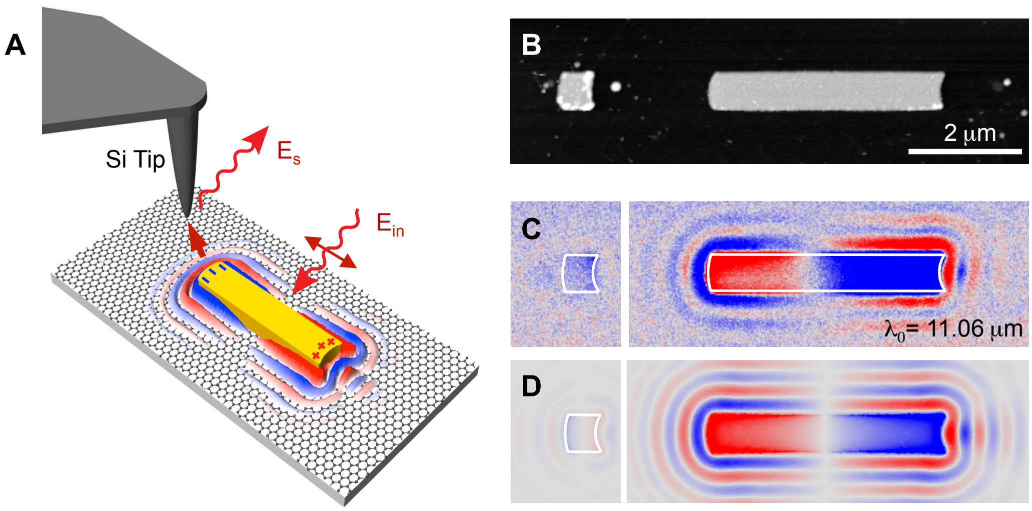

Figure 1. Experimental verification of an antenna-based graphene plasmon device. (A) Illustration of the near-field imaging method. An illuminating plane wave with electric field E_{in} drives an antenna resonance in a metal nanorod. The subsequently generated near fields at the rod extremities launch plasmons in the graphene sheet, which covers the substrate. A dielectric Si tip scans the sample surface and scatters the local near fields at the sample surface. (B) Topography image of an off- and on-resonance dipole antenna (left and right, respectively). (C,D) Experimental near-field images, showing the real part of the vertical near-field component of the antenna shown in B.