# Two-Dimensional Optics with Graphene Plasmons Launched by Metal Antennas

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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 [1,2]. The huge momentum mismatch between graphene plasmons and photons, however, presents a major technological challenge. Here, we present and discuss the coupling of incoming light into propagating graphene plasmons based on resonant optical antennas, constituting an essential step for the development of graphene plasmonic circuits [3]. The antennas were fabricated by electron beam lithography on CVD-grown monolayer graphene. By interferometric near-field microscopy we map the propagating plasmons launched by the antennas (Fig. 1). Focusing and refraction of antenna-launched graphene plasmons will be demonstrated and discussed.

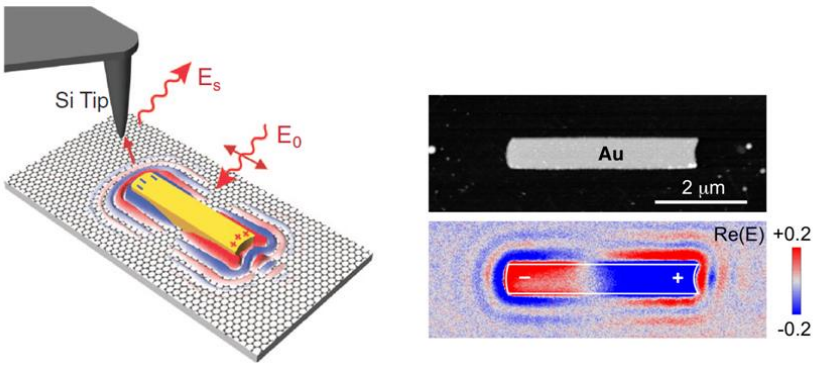


**Figure 1.** Launching graphene plasmons with a metal antenna. Left: Schematics of the s-SNOM experiment. Right: Topography of a gold nanoantenna on graphene (top) and near-field image showing the fields of the antenna and the graphene plasmons around the antenna (bottom). The near-field image was taken at an illumination wavelength of 11.06 µm and shows the real part of the imaged field. The distance between fringes of the same color reveals the graphene plasmon wavelength.

## References

[1] J. Chen, et al., Nature 487, 77 (2012)
[2] [2] Z. Fei, et al., Nature 487, 82 (2012)
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