Theory for scattering of graphene surface plasmons

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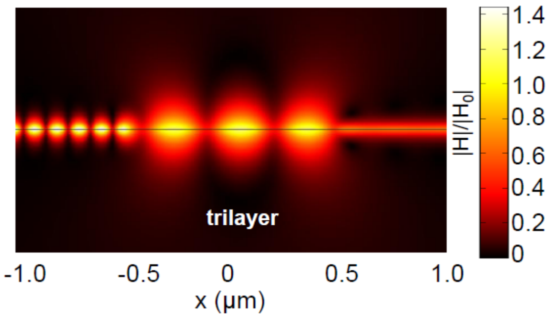
As has been recently demonstrated, graphene surface plasmons (GSPs) can propagate along a monolayer [1,2]. It is known that graphene samples can contain various inhomogeneities or defects. For instance, in CVD graphene, multilayer domains and cracks are produced during the fabrication process. The non-uniformity can be also created externally, for example as the changes of conductivity in gate-induced p-n or p-n-p junctions. Both natural and artificial defects can essentially affect the propagation of GSPs.
We present an extensive study of GSP scattering by different types of inhomogenetics. Two main cases are considered: smooth variations of the graphene conductivity (characterized by a Gaussian conductivity profile) and sharp variations (represented by islands with different conductivity or cracks). By conducting both numerical and analytical analysis, we find a universal scaling for GSP reflection. We discuss interesting combinations of parameters, where for example GSP reflection is very low for high-contrast inhomogeneties or, in contrast reaches unity for smooth variation of the conductance.



Snapshot of the magnetic field norm for a GSP propagating in a graphene monolayer and impinging (from left to right) onto a trilayer island of the width 1μm. Free-space wavelength is 10μm, Fermi level is 0.2 eV.

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