Graphene plasmonics with a drift-current bias

Mário G. Silveirinha[(1)]
Tiago A. Morgado[(2)]
Filipa R. Prudêncio[(1)]
[(1)] Instituto Superior Técnico and Instituto de Telecomunicações, Av. Rovisco Pais 1, 1049-001 Lisboa, Portugal
[(2)] Instituto de Telecomunicações and Department of Electrical Engineering, University of Coimbra, 3030-290 Coimbra, Portugal
mario.silveirinha@co.it.pt

Abstract

We will present an overview of our recent work on plasmonics in a drift-current biased graphene platform [1]-[4]. We will show that such a system provides a novel route to break the time-reversal symmetry and achieve strong nonreciprocal responses at the nanoscale. Our theoretical and numerical studies demonstrate that the biasing of a graphene sheet with a drift electric current enables the propagation of unidirectional surface plasmons and originates a highly asymmetric electron energy loss spectrum. Furthermore, it will be highlighted that a drift-current biased graphene system is an active system. In particular, it will be shown that by coupling the drift-current biased graphene sheet to another plasmonic slab (e.g., a semiconductor slab), it is possible to obtain regimes of negative Landau damping wherein the surface plasmons are pumped by the drifting electrons.

REFERENCES

[1] T. A. Morgado, M. G. Silveirinha, “Negative Landau damping in bilayer graphene,” Phys. Rev. Lett., vol. 119, 133901, September 2017.
[2] T. A. Morgado, M. G. Silveirinha, “Drift-induced Unidirectional Graphene Plasmons,” ACS Photonics, vol. 5(11), pp. 4253-4258, October 2018.
[3] T. A. Morgado, M. G. Silveirinha, “Nonlocal effects and enhanced nonreciprocity in current-driven graphene systems”, Phys. Rev. B, 102, 075102, 2020.
[4] F. R. Prudêncio, M. G. Silveirinha, “Asymmetric Electron Energy Loss in Drift-Current Biased Graphene”, Plasmonics, doi.org/10.1007/s11468-020-01215-6, 2020.

FIGURES

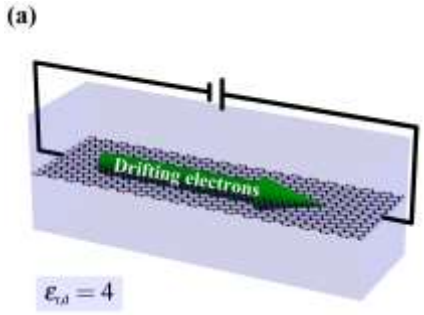

Figure 1: Sketch of a graphene sheet biased with an electric drift current.