PhD Position

Nonlinear Graphene Plasmonics: Towards All-Optical Light Manipulation on a Chip

SUMMARY

This project will focus on theoretical and numerical studies of the novel platform for light guidance and manipulation at miniature nano-metre scale: graphene plasmonic circuits.

Details of the Project

Similar to thin metal films, graphene supports propagation of surface plasmon polariton (SPP) waves, characterized by extreme confinement of electromagnetic energy on sub-wavelength nano-metre scale. The advantages of graphene SPPs over their conventional metal analogues include:

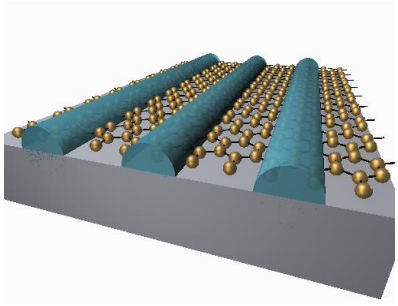

Fig. 1 Schematic view of an array of graphene plasmonic waveguides integrated on a chip.

- Much lower losses, particularly in mid-infrared
- Tunable optical response, including dynamical tuning via voltage gating
- Strong localization of graphene SPPs in a wide wavelength range
- Exceptionally strong nonlinearity of graphene

In this project you will focus on development of nonlinear elements of graphene SPP-based plasmonic circuits, including nonlinear waveguide couplers and arrays, X- and Y-splitters, ring resonators, periodic structures. Project tasks include:

- Derivation of slow-light type models for analysis of graphene SPP propagation in various planar structures, starting from Maxwell equations with nonlinear boundary conditions.
- Numerical modelling of nonlinear graphene SPP propagation, switching, frequency conversion.
- Perturbation analysis of nonlinear stationary modes.
- Design of functional all-optical logic elements.

Applications: Applicants should have a background in the physical sciences and have or expect to gain a First or good Upper Second Class UK Honours degree, or the equivalent from an overseas University. Possible funding sources include the Doctoral Training Account (for UK applicants) or Faculty/University studentships and scholarships. Applications from self-funded students are always welcome.

Contact Dr. Andriy Gorbach (A.Gorbach@bath.ac.uk, http://people.bath.ac.uk/ag263) for further information.

References:

[1] A. V. Gorbach, Phys. Rev. A **87**, 013830 (2013).
[2] A.V. Gorbach, Photonics **2**, 825 (2015).
[3] H. Yan, T. Low, W. Zhu, Y. Wu, M. Freitag, X. Li, F. Guinea, P. Avouris, and F. Xia, Nat. Photonics **7**, 394 (2013).