Enhanced THz Nonlinearity in Graphene and Graphene-based Materials

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Graphene, a two-dimensional crystal of carbon atoms arranged in a hexagonal lattice, has attracted a great attention due to its outstanding mechanical, thermal and electronic properties. In addition, graphene shows a strong tunable light-matter interaction that depends on the Fermi level. For practical use of graphene in broadband nonlinear photonic applications, however, substantial increases of the light–matter interaction strength will be required while preserving the promising features of monolayers, as the interaction of light with a single atomic layer is limited due to the extremely short interaction length and low density of state, particularly for the long-wavelength region.
In the present talk, boosting the nonlinearity by random stacking of high-quality monolayer graphene up to a requested number of layers, which leads to the electronic interaction between layers being effectively switched off due to turbostratic disorder, will be presented [1]. The nonlinear characteristics of randomly stacked multilayer graphene (RSMG) show clear improvements in the terahertz (THz) regime with increasing layer numbers, whereas as-grown multilayer graphene (AGMG) exhibits limited behaviors due to strong interlayer coupling. Furthermore, enhanced nonlinearities will be shown in graphene-based metamaterials and nanogap structures. Such controllable nonlinearity enhancement provides an ideal prerequisite for developing efficient graphene-based THz photonic devices [2,3].

References

[1] I. H. Baek et al., 2D Mater. **4** (2017) 025035
[2] H. J. Choi et al., Sci. Rep. **7** (2017) 42833
[3] Y.-M. Bahk et al. Phys. Rev. Lett. **115** (2015) 125501