Ultrafast Carrier Dynamics in Hybrid Plasmonic Nanostructured metal/graphene

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Abstract

Graphene plasmonic circuits critically depend on converting incident light into propagating graphene plasmons (GPs), and on controlling their propagation and focusing to enhance light-matter interactions. Here, the theoretical analysis and experimental studies are mainly focused on the GP induced hot-carrier generation and injection on graphene when energy transferred at different SPP interference states. We characterize the ultrafast carrier dynamics in the hybrid metal/graphene nanostructures using ultrafast pump-probe spectroscopy in the mid-inferred range. The renormalized plasmon dispersions in the interface of the metal/graphene nanostructures are investigated. And, the characterization of nonlinearity phase of the high order harmonic generation signals of the hybrid naonstructures are also demonstrated.

References

[1] P. Alonso-González, A. Y. Nikitin, et.al., Science, 344 (2014) 1369
[2] Martin Mittendorff, Stephan Winnerl, Harald Schneider, et.al., Nature Physics, 11 (2015) 75
[3] Petr Dvořák, et.al., Nano Lett., 13 (2013) 2558
[4] Achim Woessner, et.al., Nature Photonics, 11 (2017) 421

Figures

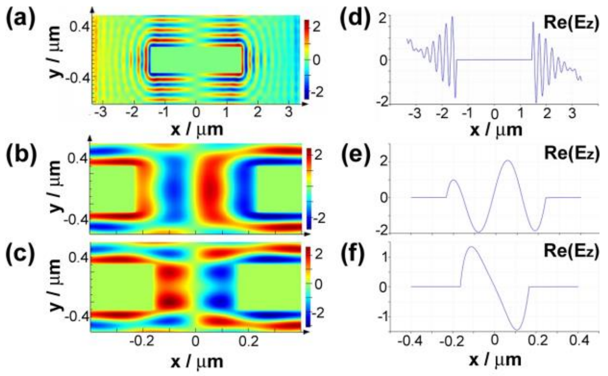

Figure 1: Simulation results of the SPP excited by linearly polarized laser of 10.6 μm and their interferences between the Au nanostrips pair on monolayer graphene. (a) SPP excitation and propagation around an Au Nanostrip on a monolayer graphene transferred on Si with a size of 2.9μm*0.6μm*0.05μm, where the λ_{sp}~250nm; (b) the constructive interference of the SPP between the Au Nanostrip pair with a separation of $2\lambda_{sp}$ on graphene; (c) the destructive interference of the SPP between the Au Nanostrip pair with a separation $1.5\lambda_{sp}$.

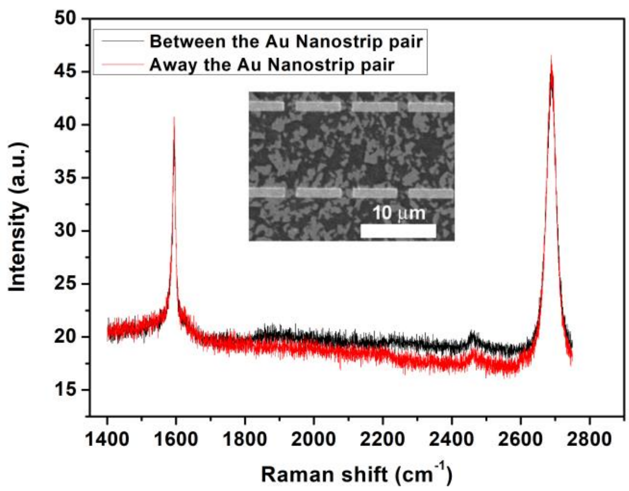

Figure 2: The Raman spectra on the Au Nanostrip (with a size of 2.9μm*0.6μm*0.05μm) pair array on monolayer graphene transferred on Silicon substrate, the inset is the SEM image of the Au Nanostrips array with two separations of 760 nm (~3 λ_{sp}) and 5 μm.