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Mid-infrared Polaritonic Coupling between Boron Nitride Nanotubes and Graphene

Boron nitride (BN) is a promising substrate for graphene-based devices in part because its large band gap can serve to insulate graphene in layered heterostructures. At mid-infrared frequencies, graphene supports surface plasmon polaritons (SPPs), whereas hexagonal-BN (*h*-BN) is found to support surface phonon polaritons (SPhPs). We describe the observation of infrared polaritonic coupling between graphene SPPs and boron nitride nanotube (BNNT) SPhPs. Infrared scattering type scanning near-field optical microscopy is used to obtain spatial distribution of the two types of polaritons on the nanoscale. The observation suggests that those polaritons interact at the nanoscale in a one-dimensional/two-dimensional (1D/2D) geometry, exchanging energy in a nonplanar configuration. Control of the polaritonic interaction is achieved by adjustment of the graphene Fermi level through voltage gating. Our finding indicates that boron nitride nanotubes and graphene can interact at mid-infrared frequencies and coherently exchange their energies at the nanoscale through the overlap of mutual electric near field of surface phonon polaritons and surface plasmon polaritons. Such interaction enables the design of nano-optical devices based on BNNT-graphene polaritonics in the mid-infrared range.

References

[1] Xiaoji G. Xu, Jian-Hua Jiang, Leonid Gilburd, Rachel G. Rensing, Kenneth S. Burch, Chunyi Zhi, Yoshio Bando, Dmitri Golberg, and Gilbert C. Walker ACS Nano 2014 8 (11), 11305-11312

Figures

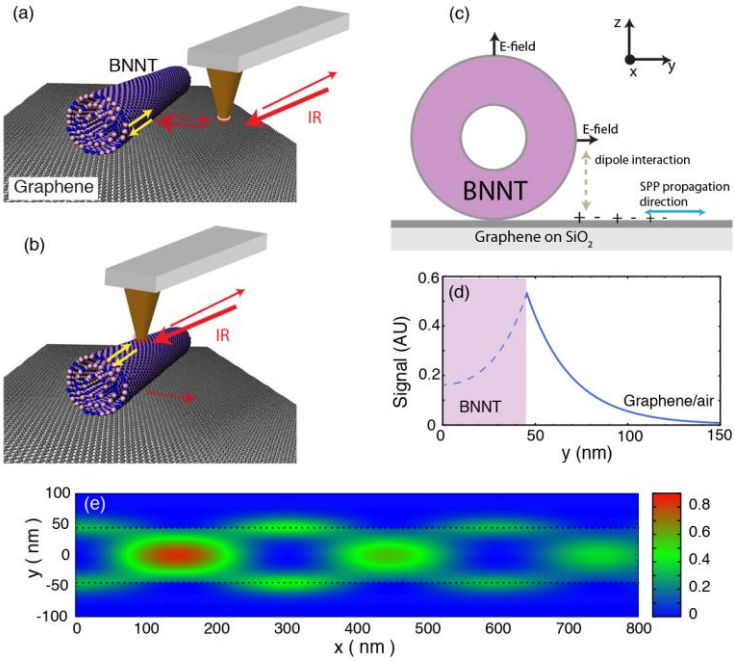

Figure 1: Scheme of near-field interaction and signal generation