Local Plasmon Engineering in Doped Graphene

Single-atom B or N substitutional doping in single-layer suspended graphene, realized by low-energy ion implantation, is shown to induce a dampening or enhancement of the characteristic interband π plasmon of graphene through a high-resolution electron energy loss spectroscopy study using scanning transmission electron microscopy. A relative 16% decrease or 20% increase in the π plasmon quality factor is attributed to the presence of a single substitutional B or N atom dopant, respectively. This modification is in both cases shown to be relatively localized, with data suggesting the plasmonic response tailoring can no longer be detected within experimental uncertainties beyond a distance of approximately 1 nm from the dopant. Ab initio calculations confirm the trends observed experimentally. Our results directly confirm the possibility of tailoring the plasmonic properties of graphene in the ultraviolet waveband at the atomic scale, a crucial step in the quest for utilizing graphene’s properties toward the development of plasmonic and optoelectronic devices operating at ultraviolet frequencies.

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