Enhanced light-absorption in graphene-metamaterial hybrids

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Abstract

The scope of surface plasmon-related phenomena has been increasing swiftly in the past decade, spanning metallic nanowires, band-gap nanostructures, metallic nanoparticles, and other nanoengineered materials. With the recent advent of graphene and related two-dimensional crystals, a new playground for plasmonics has emerged [1]. The characteristic electronic properties of graphene originate the most distinct electromagnetic confinement behavior, such as plasmonic propagation lengths exceeding those of conventional metal-dielectric interfaces [2], and guided transverse-electric modes with tunable frequency [3,4].

The observation of prominent plasmonic absorption peaks in graphene micro-arrays [5] has triggered a new research line, in which plasmonic excitations are explored to overcome the major obstacle in graphene-based opto-electronics: the small light absorption in one-atom thick graphene systems.
In this work, we propose a hybrid graphene-metamaterial system, where a single and continuous graphene sheet is seen to absorb all the light impinging on it [6]. The frequency range for enhanced absorption is determined by the properties of the metamaterial alone, allowing subsequent control over the absorbed plasmonic waves to be performed in the graphene sheet (e.g., via chemical doping).

References

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Figures