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标题: Tunable infrared plasmonic devices using graphene/insulator stacks
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摘要: The collective oscillation of carriers-the plasmon(1-17)-in graphene has many desirable properties, including tunability and low loss(11-14,16,17). However, in single-layer graphene, the dependence on carrier concentration of both the plasmonic resonance frequency and magnitude is relatively weak(16,17), limiting its applications in photonics. Here, we demonstrate transparent photonic devices based on graphene/insulator stacks, which are formed by depositing alternating wafer-scale graphene sheets and thin insulating layers, then patterning them together into photonic-crystal-like structures(18). We show experimentally that the plasmon in such stacks is unambiguously non-classical. Compared with doping in single-layer graphene, distributing carriers into multiple graphene layers effectively enhances the plasmonic resonance frequency and magnitude, which is different from the effect in a conventional semiconductor superlattice(3,4) and is a direct consequence of the unique carrier density scaling law of the plasmonic resonance of Dirac fermions(8,16). Using patterned graphene/insulator stacks, we demonstrate widely tunable far-infrared notch filters with 8.2 dB rejection ratios and terahertz linear polarizers with 9.5 dB extinction ratios. An unpatterned stack consisting of five graphene layers shields 97.5% of electromagnetic radiation at frequencies below 1.2 THz. This work could lead to the development of transparent mid-and far-infrared photonic devices such as detectors, modulators and three-dimensional metamaterial systems(19,20.)
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