Enhanced Ultraviolet Absorption in Graphene based on Metal-Dielectric-Metal Structure

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Graphene has the potential in developing novel optoelectronic and photonic devices due to its exceptional electrical and optical characteristics. However, in the ultraviolet (UV) frequency, it is still a critical issue to realize high absorption rate inside graphene due to the weak interaction between graphene and the incident light. Herein, we propose a graphene-based metamaterial composed of single layer graphene sandwiched between aluminum (Al) nanoparticles (NPs) and Al substrate as shown in Fig. 1. In order to prevent the carrier transportation between Al and graphene, Al_2O_3 layers are inserted between graphene and Al layers. The Al substrate with a thickness of 50 nm acts as a mirror to reflect the incident light and block the transmitted power. The metal-dielectric-metal (MDM) plasmonic structure could achieve a high absorption rate of ultraviolet incidence up to 29% with *TE* polarization and 36% with *TM* polarization as shown in Fig. 2. Moreover, the MDM structure can tolerate a wide incident angles from 0 ° to 60 °, while the absorption spectrum keeps almost unchanged. Our research provides an important theoretical guide for designing novel optoelectronic devices based on graphene in the ultraviolet region.

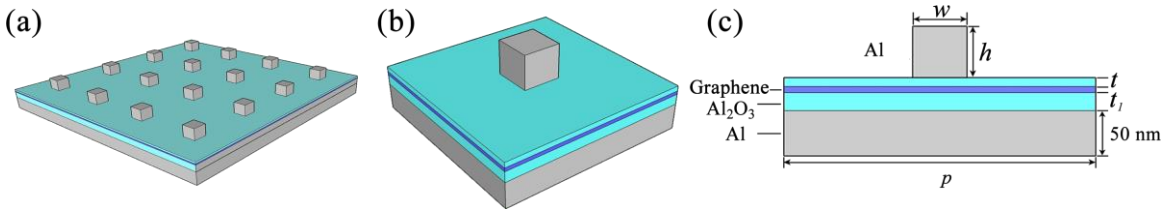

Fig.1 UV enhancement structure of (a) perspective view, (b) unit cell, (c) cross-section view. The symbols *w*, *h* and *p* denote the width, thickness and periodic spacing of aluminum NPs. The symbols *t* and t_1 denote the thickness of the upper and lower Al_2O_3 layer, respectively.

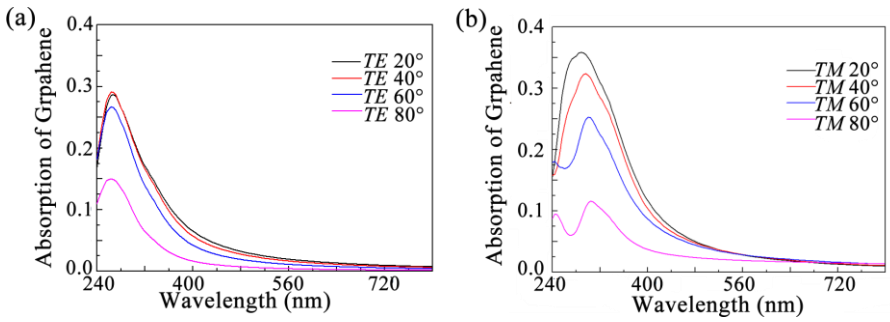

Fig.2 UV light absorption of graphene with different incident angles of (a) *TE* polarization, (b) *TM* polarization.