Ultralow threshold visible random lasing from vertical graphene network

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Abstract:

In modern-day technology, lasers are increasingly utilized for different applications.[1] However, preparation of laser has been hindered due to its sophisticated design and expensive production cost, which may limit the suitable choice of materials and the lasing wavelengths. In contrast, random laser attracted much attention to circumvent these shortcomings with simpler fabrication process, lower processing cost, material flexibility for any lasing wavelengths with lower lasing threshold.[2] In this work, we demonstrated ultralow threshold random laser action from perovskite nanocrystal assisted by highly pours vertical-graphene-nanowalls (GNWs) network. This is the first attempt to design a laser device assisted with such highly porous graphene network. The observed laser actions confirm ultralow threshold energy density of 10 nJ-cm^{-2}, which is attributed to the strong photon trapping within the GNWs. In addition, the GNWs with the assistance of silver plasmonic show a great enhancement of plasmonic response and reduce the lasing threshold ~10 times. We further demonstrate that our strategy is highly reproducible and it can be extended to several other semiconducting materials, which can facilitate us with arbitrary laser frequency. Moreover, we have supported our observations by recording the time-resolved photoluminescence spectra and angular dependence of the emission lines. Our work paves a useful step towards the realization of high-performance optoelectronic devices and it can attract widespread attention towards the practical implementation of random lasing devices.

References:

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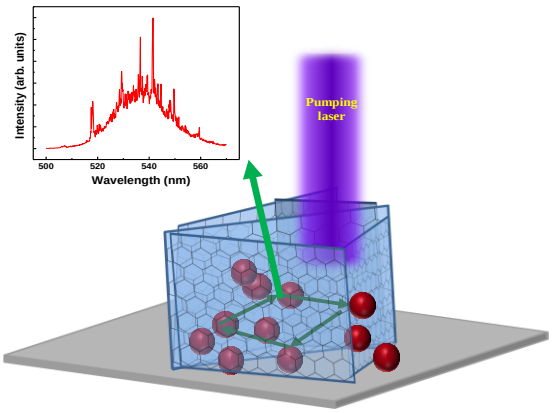

Figure1: Schematic illustration of random laser working mechanism in vertical graphene.

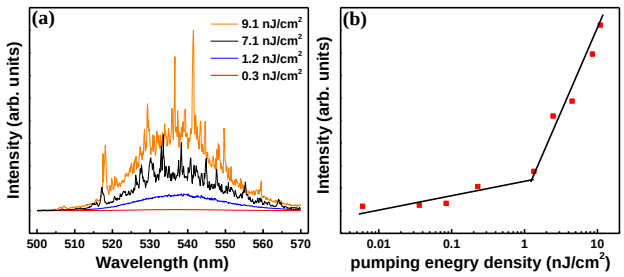

Figure 2: (a) Output emission spectra of Ag/ SiO_2 coated EGNWs/PQDs devices (b) The dependence of integrated intensities with different pumping energy density.