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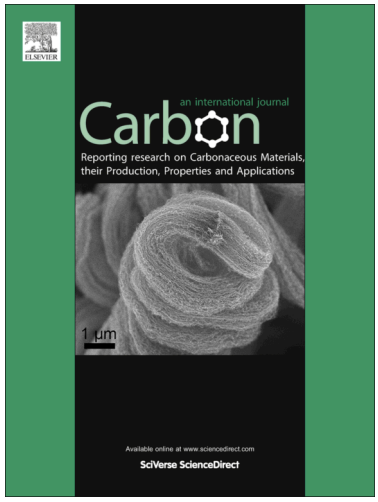

Versatile photoluminescence from graphene and its derivatives

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Versatile photoluminescence from graphene and its derivatives

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Abstract

Graphene and its derivatives exhibit many interesting photoluminescence (PL) properties because of their unique electronic structures. In spite of the absence of the band gap, graphene shows PL due to hot electrons. Graphene oxide (GO) fluorescence is different from that of a single organic fluorophore, for which the spectral properties and emission lifetime are independent of wavelength. Single-layered GO sheets are made of a large number of covalently connected independent fluorophores of varying sizes. These fluorophores are aromatic π-conjugated sp^2-hybridized subsystems of carbon atoms surrounded by sp^3 regions. The PL of GO is pH dependent because of the presence of many oxygen containing groups in GO sheets. Reduced graphene oxide (RGO) PL is somewhat different from GO because the number and size of sp^2 fragments are increased in RGO due to the elimination of the functional groups containing oxygen via reduction. Nano-sized graphene/GO possesses the strong quantum confinement effect and hence emits intense excitation wavelength dependent PL. Moreover, graphene quantum dots (GQDs) show upconverson PL due to anti-Stokes transition. The diverse PL properties including the effect of reduction, pH and solvent have been reported in many recent studies. Here I review the versatile PL features of graphene derivatives to elucidate the mechanism of PL.

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