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REVIEW

Recent Analytical and Environmental Approaches on Graphene Based Materials for Toxic Heavy Metals and Dye Pollutants

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ABSTRACT

Recent approaches on synthesis and characterization of graphene based materials are reviewed. Some typical materials include graphene oxide, graphene oxide modified with thiol and amino groups, nanocomposite of graphene-metal oxides and graphene quantum dots. Graphene oxide posses a wide range of impressive properties with numerous studies of dye adsorption. The modified functional graphene oxides have also been applied for removal of some toxic heavy metals in aqueous solution. Regarding thermodynamic and kinetics study, their adsorption isotherms are well-known established according to their multifunctional materials. Some ternary nanocomposite materials with or without magnetic property of specific graphene-metal/metal oxide or biopolymers have been used in both photocatalytic and sonocatalytic degradation of different industrial dye pollutants. In addition, graphene quantum dots as either chemical sensor or biosensor *via* turn-on/turn-off on its fluorescence were mostly applied for highly sensitive and selective detection of inorganic and organic compounds in real samples.

KEYWORDS

Graphene oxide, Graphene quantum dots, Multifunctional groups, Nanocomposite, dye, Heavy metal, Photocatalytic, Sonocatalytic, Chemical sensor.

INTRODUCTION

Carbon, one of the most abundant elements on the earth, brings us as star materials over and over again. The football-shaped fullerenes and needle-liked carbon nanotubes (CNTs), both as new allotropes of carbon, attract great interests from scientists of chemistry, physics, biology and medical sciences. Graphitic forms include 0D fullerene, 1D CNT and 3D graphite and 2D case comes to graphene, a single layer of carbon atoms formed in honeycomb lattice, which was rewarded with Nobel Prize in Physics in Year 2010 [1]. Graphene, one layer of sp^2 bonded carbon in a honeycomb lattice, or more simply, one single layer of graphite, was discovered by Geim, Novoselov and co-workers (2004) at University of Manchester [2,3]. A wide range of impressive properties has been reported for graphene including the following: high electron mobilities of

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