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Facile synthesis of multifunctional graphene oxide/AgNPs-Fe_3O_4 nanocomposite: A highly integrated catalysts

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HIGHLIGHTS

- The nanocomposite graphene oxide/AgNPs—Fe_3O_4 is simple to be synthesized.
- GO is an outstanding support which can improve the sensitivity of catalysis.
- GAMN perfectly combined the magnetic property and catalytic activity together.
- The composite possess enhanced catalytic capacity and good reusability.
- They exhibit great potential in environmental pollutant degradation.

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ABSTRACT

A functional GO/AgNPs nanocomposite was obtained by in situ reduction of positively charged $AgNO_3$ precursors which were adsorbed on the negatively charged surface of GO through electrostatic attraction. GO/Ag—Fe_3O_4 magnetic nanoparticles (GAMNs) were generated via an amidation reaction in the presence of 1-ethyl-3-(3-dimethyaminopropyl) carbodiimide and N-hydroxysuccinnimide for the first time. The catalysis property of the nanocomposite was studied by degrade 4-nitrophenol. The characterized results proved that AgNPs and Fe_3O_4 have been successfully decorated on GO nanosheets. The GAMNs possess high catalytic capacity and good reusability, and exhibit great potential in environmental pollutant degradation.

1. Introduction

Noble metal nanoparticles (NPs) have received immense scientific and technological interest in applications including optoelectronics [1], sensing [2,3], biomedicine [4], etc. Among these materials, silver nanoparticles (AgNPs) have been found with great potentials in magnetic-hyperthermia [5], photothermal therapy [6,7], CT contrast agent [8] and sensitive IR-induced killing of cancer cells [9]. AgNPs have been taken as highly promising antibacterial agents due to their capabilities of releasing bactericidal Ag^+ [10–13]. Besides, AgNPs possess unique plasmon-resonant optical scattering properties that are used in optical labels such as signal enhancers, optical sensors, and biomarkers [14]. In particular, AgNPs have been proven to be promising candidates in catalysis, so many excellent catalyst based on AgNPs has been prepared. Xueping Zhang et al. have fabricated a nanoscale composite consisting of nanosized Ag catalysts and nickel silicate (NS)-coated Fe_3O_4 microspheres [15]. Xu et al. have synthesized Au@Ag core–shell nanoparticles stabilized on metal-organic framework [16] to catalyze degradation of 4-nitrophenol.

It is well studied that the catalytic properties of NPs are greatly affected by their support. Several studies have shown that the crystal facet of the support NCs can also exert profound effects on the active phase and thus the catalytic activity [17]. The mechanism of catalysis clearly states that catalysis proceeds through an electrochemical mechanism. And the catalytic efficiency of such particles greatly depends on their size-dependent redox properties [18]. So the highly conductive supports such as carbon nanotubes and graphene oxide (GO) are widely used as catalyst supports. Graphene oxide, a two-dimensional sheet of carbon arranged in a hexagonal lattice, has fascinated the scientific community in recent years

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