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One-step size-controlled synthesis of functional graphene oxide/silver nanocomposites at room temperature

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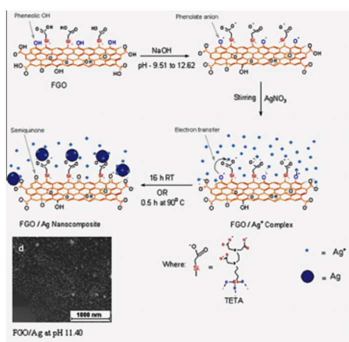
HIGHLIGHTS

- Simple room temperature synthesis of functional GO/Ag nanocomposite was described.
- Aqueous stability of the GO and nanocomposite improved due to the functional groups.
- The size of Ag nanoparticles can be controlled by adjusting solution pH.
- SERS and antibacterial property greatly depend on the Ag nanoparticles size.

GRAPHICAL ABSTRACT



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ABSTRACT

A stable aqueous suspension of functional graphene oxide/silver nanocomposite (FGO/Ag) was prepared in an alkaline medium by a simple room temperature stirring method. Functional graphene oxide (FGO) served as substrate, reducing agent and stabilizer for the silver nanoparticles (Ag-NPs). The pH of the solution played a prominent role in the formation of the Ag-NPs. The morphology of the nanoparticles (NPs) could be controlled by adjusting the pH between 9.51 and 12.62 by adding NaOH solution. The aqueous stability of the nanocomposites was greatly improved by the attached functional groups. UV-visible spectroscopy, transmission electron microscopy (TEM) and field emission scanning electron microscopy (FESEM) images suggested the formation of spherical, Ag-NPs with a narrow size distribution at pH 11.40. The nanocomposites showed high bactericidal activity against *Escherichia coli* bacteria and also enhancement in Raman intensity due to surface enhanced Raman scattering (SERS), which was found to be dependent on the size distribution of the Ag-NPs. This work provides a simple, scalable and environmentally friendly approach to the preparation of a FGO/Ag nanocomposite with promising antibacterial and SERS properties.

1. Introduction

Graphene oxide (GO), an oxygenated, layered hydrophilic carbon material, is usually derived by ultrasonication of graphite oxides. These materials have attracted interest because of their availability in bulk quantities, readily functionalization in chemical reactions, good dispersal in water and high compatibility with living cells [1,2]. These distinct advantages make them appealing, either as single components in, for example, paper-like materials, as fillers in polymers, or as nanohybrids with metals and nonmetallic nanoparticles for various applications [3]. Insertion of nanoparticles (NPs) in a graphene-based matrix is an important study for the exploration of their properties and applications. So

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