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Reduced Graphene Oxide Functionalized Magnetic Nanocomposites for Environmental Pollutant Removal

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Abstract. Nowadays the excessive and uncontrolled discharge of chemicals are imposing major health threats. The demands for clean and safe water amplifies the need to develop improved technologies for environmental contaminant removal. Considering the limitations of conventional methods for contaminants removal, we have prepared magnetic iron oxide nanoparticles functionalized with reduced graphene oxide as a potential material for environmental pollutants removal. The magnetic properties in potential adsorbent materials are highly desirable due to several advantages. Among which are their large adsorptive surface area, low diffusion resistance, high adsorption capacity and fast separation in large volumes of solution. The surface functionalized magnetic iron oxide nanoparticles (MNP) were fabricated using a one-pot solvothermal method by adding reduced graphene oxide (rGO) into the reaction system. The graphene oxide was reduced prior to the addition in the hydrothermal decomposition step. The resultant rGO-MNP nanocomposites were characterized using FT-IR, SEM and VSM to investigate the functional groups, morphology and magnetic properties, respectively. We also demonstrated the potential of the hybridized magnetic material with hydrophobic reduced graphene oxide for environmental pollutant removal.

Introduction

Research surrounding nanoparticles have seen a rapid increase in terms of development and sample preparations [1, 2]. Its nanometer sized-scale offers high surface area-to-volume ratio that leads to a much greater extraction capacity and efficiency compared with other adsorbents. Among the various types of nanoparticles, magnetic nanoparticles (MNP) became the focus of many research fields such as catalysis [3], cancer treatment [4, 5] and bioimaging [6]. The magnetism possesses by the MNP enable quick separation of MNP and adhered analytes from aqueous environment using external magnetic field. This method of separation is simple and quick excluding expansive and complex methods such as centrifugations and filtration. Addition, the surface of MNP can be easily functionalized to attract specific analyte for selective extraction.

Graphene oxide (GO) a subset material of graphene has gained numerous attention due to its abundance of active oxygen-based functional groups including carboxylic, carbonyl, epoxy, or hydroxyl groups around their structure [7]. This offers available sites for nanoparticles such as MNP to be immobilized on the surface of GO. It has been suggested that the immobilization of MNP on the GO-sheet could improve its stability and increase its surface area [8].

Microplastics have been reported as ubiquitous pollutants across coastal environments with significant impacts on the marine ecosystem and organisms [9, 10]. Many efforts have been made in order to remove this imposing pollutant from aqueous system [11, 12]. In this work, reduced GO incorporated with MNP composites were fabricated in a facile one-pot method. The hydrophobic