Supporting Information

Magnetic graphene oxides as highly effective adsorbents for rapid removal of a cationic dye rhodamine B from aqueous solutions

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Experimental

Synthesis of Fe$_3$O$_4$ magnetic nanoparticles-graphene oxide (MNPs-GO):

Graphite oxide was prepared from nature graphite powder using a Hummers method with a slight modification.$^1$ Firstly, H$_2$SO$_4$ (95%) (46 mL) was added into a 500 mL flask, and then cooled by immersion in an ice-water bath. Subsequently, graphite powder (1.0 g) and NaNO$_3$ (0.5 g) were added under vigorous agitation to avoid agglomeration. KMnO$_4$ (6.0 g) was added into the suspension very slowly under stirring and the temperature of the mixture was kept lower than 10 °C. The ice-water bath was then removed, and the mixture was stirred at room temperature for 2 h. H$_2$O (92 mL) was slowly added into the mixture with vigorous stirring. The temperature of the mixture increased to near 100 °C due to the addition of water and the color of the mixture changed from black to brown. Then, the mixture was diluted by adding 280 mL of H$_2$O. Further, 5 mL of H$_2$O$_2$ (30 wt. %) was added to the mixture. Finally, the mixture was filtered, washing with 10 % HCl and then de-ionized water. After filtration and drying at room temperature under vacuum, graphite oxide (GO) was obtained as a grey powder.

To synthesize the MNPs-GO hybrid, 0.5 g of prepared GO was added into a 250 mL flask, 30 mL of H$_2$O was added under vigorous agitation. FeCl$_3$·6H$_2$O (0.8 g) and FeCl$_2$·4H$_2$O (0.3 g) pre-dissolved in 10 ml de-ionized water were added into the flask in a moment. After this, 15 mL of NH$_4$OH aqueous solution (29 %) was added rapidly. The hybrid MNPs-GO was obtained after the mixture was kept stirring at room
temperature for 2h. The product was separated from the solvent by using a magnetic force and washed with de-ionized water for several times, and then dried at room temperature under vacuum. Fe$_3$O$_4$ nanoparticles (MNPs) was prepared by the same procedure without the addition of GO.

**Characterization:**

Transmission electron microscope (TEM) images of GO and MNPs-GO were obtained on an H-7500 Hitachi transmission electron microscope. The Fourier transform infrared (FTIR) spectra of the two samples were observed by Thermo Nicolet 360-FTIR spectrometer. The crystal structures of GO and MNPs-GO were measured by MSAL-XD2 X-ray diffracto-meter. The magnetic properties were investigated at room temperature using a vibrating sample magnetometer (VSM, LDJ 9600, LDJ Electronics Company of USA). The AFM image was obtained with a NTEGRA. The UV adsorption spectra were performed on a UV-2500. The Raman spectra were recorded on a Lab RAM HR800. The X-ray photoelectron spectroscopy (XPS) analysis was measured on a Thermo Scientific ESCALAB 250Xi using Al K Alpha radiation.

![TEM images of MNPs-GO](image)

**Fig. S1** TEM images of MNPs-GO: The resolution (a) ×200nm, (b) ×50nm.
**Fig. S2** AFM image of GO (left) with a cross-sectional analyses (right) indicating the thickness and width at about 3.3nm and 10μm, respectively.

**Fig. S3** Raman spectra of GO, MNPs-GO and MNPs-GO-dye.

**Fig. S4** UV adsorption spectra of GO and MNPs-GO.
Fig. S5 Langmuir adsorption model

Reference