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Removal of Pb^{2+} and Cd^{2+} from aqueous solution using thiol-functionalized multi-walled carbon nanotubes as adsorbents

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ABSTRACT

Multi-walled carbon nanotubes modified with thiol groups (denoted as MWCNTs–SH) was prepared using thiourea as sources for thiol groups in hydrobromic acid, which avoided complex steps via conventional synthetic methods. The characteristic results of elemental analysis (EA), scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), and thermogravimetric analysis (TGA) showed that the thiol groups were grafted onto the MWCNTs successfully and the percent was very high, which was advantageous to the adsorption of metal ions. The effects of contact time, initial adsorbent content, solution pH and temperature on the adsorption of Cd(II) and Pb(II) with MWCNTs–SH were studied systematically. The pseudo-second-order kinetic equation fitted better than that of pseudo-first-order kinetic equation to describe the adsorption kinetics of the thiol-functionalized carbon nanotubes. The adsorption isotherms of Cd(II) and Pb(II) by MWCNTs–SH matched well with the Langmuir isotherm model with the maximum adsorption capacities of 157.73 and 187.27 mg/g, respectively. The values of ΔG^{θ} and ΔH^{θ} calculated from the experiment data indicated that the adsorption process was spontaneous and endothermic in nature.

Keywords: Heavy metal adsorption; Thiol functional groups; Multi-walled carbon nanotubes; Kinetics

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