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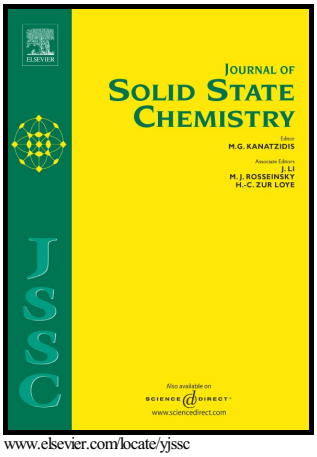

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Cysteine-functionalized silica-coated magnetite nanoparticles as potential nanoadsorbents

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Abstract

Fe_3O_4, Fe_3O_4@SiO_2, and Fe_3O_4@SiO_2@ICPTES-cysteine MNPs have been prepared by the deposition of silica onto magnetite nanoparticles via controlled hydrolysis of TEOS. The new formed silica surface has been functionalized by grafting 3-(triethoxysilyl) propyl isocyanate (ICPTES) and, subsequently, by condensation of isocyanate moiety with cysteine.

The morphology of magnetic silica nanoparticles has been investigated by FTIR, PXRD, TEM-HRTEM/SEM/EDX as well as TG experiments. HRTEM microscopy revealed that the Fe_3O_4, Fe_3O_4@SiO_2 and Fe_3O_4@SiO_2@ICPTES-cysteine nanoparticles are all of spherical shape with particle of ca. 10-30 nm diameters and the silica-coated magnetites have a core-shell structure. Fe_3O_4, Fe_3O_4@SiO_2, and Fe_3O_4@SiO_2@ICPTES-cysteine MNPs have been tested for their sorption capacity of Pb(II) from synthetic aqueous solutions and the influence of pH solution, contact time, initial heavy metal ion concentrations, and adsorption isotherms on the sorption behavior were also studied. The kinetic studies revealed that the Pb(II) sorption process is mainly controlled by chemical mechanisms. Fe_3O_4@SiO_2@ICPTES-cysteine, with a sorption capacity of 81.8 mg Pb(II)/g, has the potential to be an efficient Pb(II) adsorbent.

Graphical abstract