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Synthesis and characterization of magnetic thiol-functionalized nanoparticles for mercury remediation.

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Mercury contamination in water sources is a global problem that affects large numbers and where potential solutions from material science are of interest. There exist methods for mercury remediation in water systems such as precipitation, bioremediation, membrane filtration, and adsorption treatment [1]. However, the first three methods present more waste compared to adsorption treatment by, for example, producing contaminant residues or generating ecotoxicity. Magnetic nanoparticles collect mercury if their surfaces are coated with sulfur [2]. We have synthetized nanomaterials composed of three parts: a magnetite core, a shell-covering layer, surface modifications using 3-Aminopropyl triethoxysilane, and thiols such as cysteine, glutathione and 3-Mercaptopropyltriethoxysilane. The magnetic magnetite nucleus allows extraction after deployment in water, and we compared the size and magnetic behavior of synthetized iron oxides versus those naturally obtained from the Caribbean coast. For the shell cover, we need coatings which are non-toxic, low cost, and readily available in Colombia. We study several shell coatings such as tetramethyl orthosilicate, sodium metasilicate, chitin, chitosan, graphene oxide, and sodium ethylendiamintetraacetate, assessing their water stability and the ease of attaching thiol molecules to their surfaces. We demonstrate the performance of these nanoparticle devices and discuss how factors such as different coatings, shell thickness, and pH affect the magnetic core. For further study, we will review how these affect the ability of these devices to capture mercury and other heavy metals.

References

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