

Rapid Removal of Hg(II) from Aqueous Solutions Using Thiol-Functionalized Zn-doped Biomagnetite Particles

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DOE/Office of Environmental Management/Groundwater and Soil Remediation Program

Objective

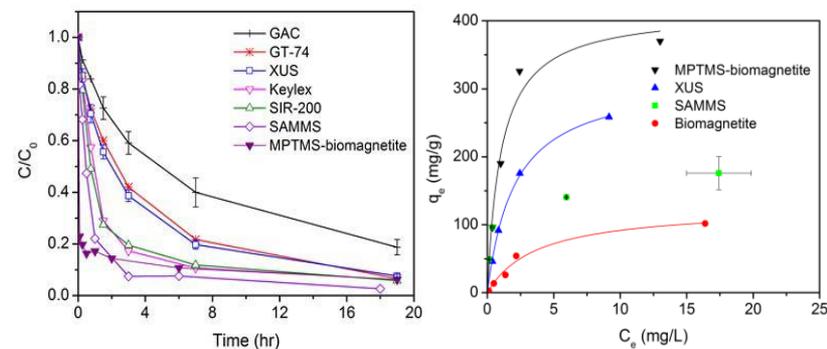
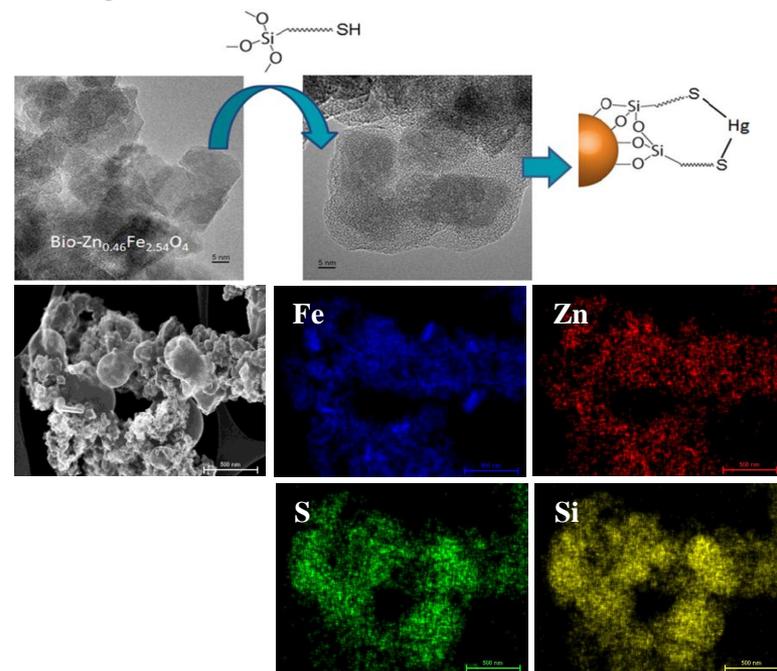
- Develop and evaluate thiol-functionalized Zn-doped biomagnetite materials for efficient Hg(II) removal from solution.
- Compare Zn-doped biomagnetite efficient Hg(II) removal from Y-12 source water to removal with commercial adsorbents.

New Science/Applied Research

- A novel nano-structured magnetite was biosynthesized, successfully doped with Zn for magnetic separation
- Surface thiol –functionalized biomagnetite shows specificity for Hg(II) extraction from solution

Significance

- Stable in a range of solutions, the thiol-functionalized Zn-doped biomagnetite removes Hg(II) in contaminated Y-12 source water efficiently and with high capacity.
- After contact the thiol-functionalized biomagnetite can be magnetically separated from treated Y-12 source water.



He, Feng; Wang, Wei; Moon, Ji-Won; Howe, Jane; Pierce, Eric; Liang, Liyuan, 2012. "Rapid Removal of Hg(II) from Aqueous Solutions Using Thiol Functionalized Zn-doped Biomagnetite Particles" ACS Applied Materials & Interfaces, in press

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Research Article

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1 Rapid Removal of Hg(II) from Aqueous Solutions Using Thiol- 2 Functionalized Zn-Doped Biomagnetite Particles

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5 Laboratory, Oak Ridge, Tennessee 37831, United States

6  Supporting Information

The surface of Zn-doped biomagnetite nanostructured particles were functionalized with (3-mercaptopropyl)trimethoxysilane (MPTMS), and then used as a high-capacity and collectable adsorbent for Hg(II) removal. Fourier transform infrared spectroscopy confirmed the attachment of MPTMS on the particle surface. The crystallite size of the Zn-doped biomagnetite was ~17nm and the thickness of the MPTMS coating was ~5nm, while the scanning transmission electron microscopy and dynamic light scattering analyses revealed that the particles aggregated in aqueous solution to form aggregates with an average hydrodynamic size of 826±32 nm. The elemental analyses suggest that the chemical composition of the biomagnetite is Zn_{0.46}Fe_{2.54}O₄ and the loading of sulfur is 3.6 mmol/g. The MPTMS modified biomagnetite has a calculated saturation magnetization of 37.9 emu/g and can be separated from water within a minute using a magnet. Sorption of Hg(II) to the nanostructured particles was much faster than other commercial sorbents and the Hg(II) sorption isotherm in an industrial wastewater follows Langmuir model with a maximum capacity of ~416 mg/g, indicating two -SH groups bind to one Hg. This new Hg(II) sorbent was stable in a range of solutions, from contaminated water to 0.5M acid solutions, with low leaching of Fe, Zn, Si, and S (<10 %).

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