

### Lanthanide ion adsorption behavior on functionalized magnetic nanoclusters

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The synthesis of SiO<sub>2</sub> coated magnetic nanoparticle has been focused for the metal ions adsorption and separation abilities due to their outstanding magnetic properties based on external magnetic field. Magnetic adsorbents were prepared with fabricating colloidal crystals and surface functionalization by using monodisperse SiO<sub>2</sub> coated magnetic nanoparticle microsphere with a core-shell structure and various functional group on surface to separate lanthanide metal ions from aqueous media. Magnetic adsorbents were synthesized in the basic condition with magnetic nanoparticles. Second surfactant, tetraethyl orthosilicate (TEOS) and ammonium hydroxide (NH<sub>4</sub>OH) via two main steps by a modified Stober process and the layer-by-layer (LbL) assembly technique due to hydrophobic surface property of magnetic nanoparticles. The hydroxide surface properties of magnetic adsorbents were functionalized to amine, carboxylate, hydroxide group by the surface modification process. The functionalized adsorbents were synthesized for use in the removal of heavy metal ions from aqueous solutions. The magnetic adsorbents were separated with external magnetic field.