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研究报告

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MY@SiO_2-PEI磁性复合生物材料对二元Ce^{3+}/Sr^{2+}混合离子的吸附性能研究

Adsorption of mixed Ce^{3+}/Sr^{2+} in binary system onto MY@SiO_2-PEI magnetic composite biomaterial

关键词：磁性材料 复合生物材料 二元体系 吸附

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作 者 单位

卞维柏 江苏大学环境与安全工程学院, 镇江 212013

黄卫红 江苏大学环境与安全工程学院, 镇江 212013

欧红香 1. 江苏大学环境与安全工程学院, 镇江 212013;2. 常州大学环境与安全工程学院, 常州 213164

朱亚梅 江苏大学环境与安全工程学院, 镇江 212013

潘建明 江苏大学化学化工学院, 镇江 212013

摘要：采用生物材料酵母作为基质材料，纳米四氧化三铁为磁敏源，3-氯丙基三甲氧基硅烷（CP）作为硅源与偶联剂，聚乙烯亚胺（PEI）为功能单体，利用两步溶液聚合法制备磁性复合生物材料（MY@SiO_2-PEI）.同时，采用FT-IR、SEM、VSM、等电位点测定及接触角测定等方法对材料的理化性能进行了表征，并考察其对二元体系（Ce^{3+}/Sr^{2+}）混合液的吸附性能及机理.结果表明，MY@SiO_2-PEI 实现了PEI的成功嫁接，材料的表面变得粗糙，等电位点pH_{zpc}变大，材料的接触角由疏水变成亲水.吸附实验结果表明，MY@SiO_2-PEI具有更好的吸附性能，对二元体系中Ce^{3+}和Sr^{2+}的最大吸附量分别为80.24 mg·g^{-1}和63.51 mg·g^{-1}.准二级动力学方程与Freundlich吸附等温模型的线性回归系数（R^2）均大于0.99，准二级动力学模拟的理论吸附容量（$Q_{e,cal}$）更接近于实验值（$Q_{e,exp}$），Freundlich等温模型中的吸附强度（1/n）均小于1，吸附为多层，有利于化学吸附过程；pH= 5.5~6.0为最适吸附pH范围；MY@SiO_2-PEI的磁性强度为10.03 emu·g^{-1}，满足分离富集的要求.

Abstract：Magnetic composite biomaterials (MY@SiO_2-PEI) were prepared through two-step solution polymerization method, which took biological material, the yeast, as the original material, nano-sized particles Fe_3O_4 as magnetism source, γ-chloropropyl trimethoxysilane (CP) as silicon source and coupling agent, and poly-ethyleneimine (PEI) as functional agent. MY@SiO_2-PEI were characterized by FT-IR,SEM,VSM,Equipotential point (pH_{zpc}) determination and Contact Angle Measurement. The adsorption performance was investigated in binary mixed solution system (Ce^{3+}/Sr^{2+}). The characterization results indicated that PEI agent were grafted onto MY@SiO_2-PEI successfully in that the surface became rough, the pH_{zpc} increased sensitively and the contact angle of MY@SiO_2-PEI became hydrophilic. The adsorption experiments illustrated that MY@SiO_2-PEI exhibited better adsorption performance than non-grafted composite and its max adsorption capacity was 80.24 mg·g^{-1} and 63.51 mg·g^{-1} for Ce^{3+} and Sr^{2+}, respectively. The linear regression coefficient (R^2) of pseudo-second adsorption kinetics was higher than 0.99 as well as Freundlich adsorption isotherm model, the academic adsorption capacity ($Q_{e,cal}$) became closer to experimental value($Q_{e,exp}$), and the adsorption strength(1/n) in Freundlich adsorption isotherm model were all less than1, which indicated that the adsorption process was chemical adsorption as well as multilayer and favorable adsorption. The best suitable pH range was 5.5~6.0 under experimental conditions. The saturation magnetization (M_s) was 10.03 emu·g^{-1} which met the needs of separation and enrichment of adsorbent.

Key words：magnetic material composite biomaterial binary system adsorption

主办单位：中国科学院生态环境研究中心

单位地址：北京市海淀区双清路18号 邮编：100085

服务热线：010-62941073 传真：010-62941073 Email：hjkxxb@rcees.ac.cn