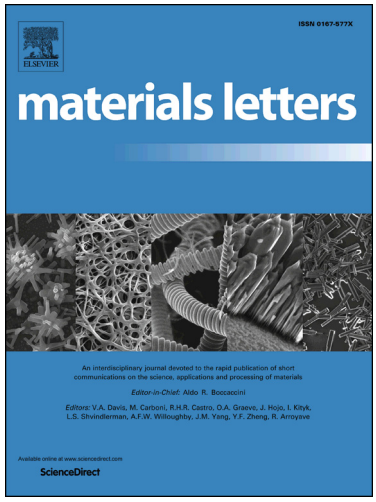

Adsorption and coadsorption mechanisms of Hg^{2+} and methyl orange by branched polyethyleneimine modified magnetic straw

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Adsorption and coadsorption mechanisms of Hg^{2+} and methyl orange by branched polyethyleneimine modified magnetic straw

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Abstract: Adsorption and coadsorption of Hg^{2+} and methyl orange (MO) were accomplished using branched polyethyleneimine modified magnetic straw. The adsorption equilibrium was achieved within 40 mins and the maximal adsorption amounts of Hg^{2+} and MO reached 320.4 and 510.2 mg/g, respectively. Thermodynamic parameters, such as ΔH^0 and ΔS^0 were found as -3.728 kJ/mol and 10.593 J/mol K for the adsorption of Hg^{2+}, while ΔH^0 and ΔS^0 were found to be -2.119 kJ/mol and 16.123 J/mol K for the adsorption of MO. It was suggested that the adsorptions of Hg^{2+} and MO were exothermic processes with further increase in the degree of freedom. The respective adsorption mechanism of Hg^{2+} and MO involved complexation and electrostatic interactions. In the binary system of Hg^{2+} and MO, the adsorption capacity of MO was not affected by the presence of Hg^{2+}, while the adsorption amount of Hg^{2+} significantly increased in the presence of MO through the mechanism of bridge enhancement. Specifically, when the initial concentration of Hg^{2+} was 0.005 mol/L, the adsorption amounts of Hg^{2+} were 510.2 and 1858.3 mg/g, respectively in the mono-component and binary systems.

Keywords: Magnetic materials; Adsorption; Heavy metal ions; Dyes; XPS

1. Introduction

Wastewater discharged from many industries such as textiles, tanning and battery manufacturing industries involves different types of toxic dyes and heavy metal ions. The exposure of these pollutants can cause severe risks for animals and humans due to their carcinogenic and mutagenic nature [1,2]. Therefore, dyes and heavy metals should be efficiently removed from the discharged wastewater in order to defend the ecological and biological environment on a global scale.

Diverse approaches have been explored for the treatment of these hazardous pollutants [3,4]. Among these techniques, adsorption is one of the effective methods for the treatment of wastewater contaminated by heavy metals and dyes compared to other methods owing to the high removal efficiency, technical feasibility, ease of operation and the absence of sludge formation [5,6].

Sorbents play a very important role in sorption treatment process. Recently,