Functionalized Mesoporous Organo-Silica Nanosorbents for Removal of Chromium (III) Ions from Tanneries Wastewater

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Abstract

Organo-silica mesoporous materials with cyano functional groups were prepared by a one pot co-condensation of 2-cyanoethyltriethoxysilane (CETS) and tetraethoxysilane (TEOS) at ratios of 1:4 and 1:9 using either sunflower oil or *n*-dodecylamine as templating agents. The tethered cyano groups were used as adsorption sites or hydrolysed to carboxylic surface functional groups. The prepared materials were characterized by diffuse reflectance infrared Fourier transform spectroscopy, atomic force microscopy (AFM), Brunauer, Emmettt and Teller, thermogravimetric analysis, transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Results indicated that materials with cyano and carboxylic surface groups were successfully prepared. AFM results indicated that primary particles with irregular shapes and grain size ranging from 0.28 ± 0.03 to 0.46 ± 0.08 µm were obtained depending on the CETS to TEOS ratio used and the structure directing template. SEM and TEM micrographs depict spherical like morphology of the same size as portrayed by AFM results. Sunflower cyano functionalized micelle template silica (MTS-S-CN) at a ratio of 1:9 had surface area of 760.5 m^2/g and average pore diameters of 3.5 nm while MTS-S-CN at a ratio 1:4 had pore diameter of 10.1 nm with surface area of 734.1 m^2/g. On the other hand, the MTS-S-COOH (1:9) had surface area of 975.9 m^2/g with pore diameter of 4.6 nm whereas MTS-S-COOH (1:4) had surface area of 740.1 m^2/g with pore diameter of 6.3 nm. The materials were used in adsorption studies of Cr(III) ions from tannery wastewater. Cr(III) ions removal ranged from 48 to 83 % depending on the adsorbent functional group and the organosilyl groups to silica ratio. This study has indicated that materials prepared were good adsorbents with an adsorption maximum of 19.7 mg Cr(III) ions per g of adsorbent.

Keywords

Mesoporous organo-silica
Nanosorbents
Tetraethoxysilane
Dodecylamine
2-(Cyano ethyl triethoxysilane)
Tannery waste water
Chromium (III) ions