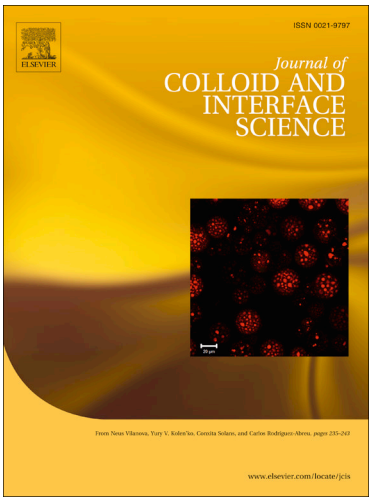

Regular Article

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Removal of chromium (VI) from aqueous solutions using surface modified composite nanofibers

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Abstract:

A novel material composite nanofibers (PAN-CNT/TiO_2-NH_2) based on adsorption of Cr(VI) ions, was applied. Polyacrylonitrile (PAN) and carbon nanotube (CNTs)/titanium dioxide nanoparticles (TiO_2) functionalized with amine groups (TiO_2-NH_2) composite nanofibers have been fabricated by electrospinning. The nanostructures and the formation process mechanism of the obtained PAN-CNT/TiO_2-NH_2 composite nanofibers are investigated using FTIR, XRD, XPS, SEM, and TEM. The composite nanofibers were used as a novel adsorbent for removing toxic chromium Cr(VI) in aqueous solution. The kinetic study, adsorption isotherm, pH effect, initial concentration, and thermodynamic study were investigated in batch experiments. The composite nanofibers had a positive effect on the absorption of Cr(VI) ions under neutral and acidic conditions, and the saturated adsorption reached the highest when pH was 2. The adsorption equilibrium reached within 30 and 180 min with an initial solution concentration increasing from 10 to 300 mg/L, and the process can be better described using nonlinear pseudo first than nonlinear pseudo second order model and Intra-particle diffusion. Isotherm data fitted well using linear and nonlinear Langmuir, Freundlich, Redlich-Peterson, and Temkin isotherm adsorption model. Thermodynamic study showed that the adsorption process is exothermic. The adsorption capacity can remain up to 80% after 5 times usage, which show good durability performance. The adsorption mechanism was also studied by UV−vis and XPS.

Keywords: Adsorption; Chromium (VI) removal; Kinetics isotherm; Electrospinning; Composite nanofibers.

1. Introduction:

Chromium is a natural metal, commonly found in wastewaters, which is originated from several industrial processes such as electroplating industries, military purposes, textile dyeing, paint, leather tanneries, and pigment industries as critical industry materials [1, 2]. Chromium possesses two oxidation states Cr(VI) and Cr(III). Cr(VI) is highly toxic, carcinogenic, mutagenic to most of the living organisms when its concentration level is higher than 0.05 ppm, and extremely mobile than Cr(III) [3-5]. Therefore, there is a great importance to remove Cr(VI) from aqueous solution, to