Synthesis of poly(hydroxamic acid) ligand from polymer grafted corn-cob cellulose for transition metals extraction

Abstract

Poly(hydroxamic acid) ligand was synthesized using ester functionalities of cellulose-graft-poly(methyl acrylate) copolymer, and products are characterized by Fourier transform infrared spectroscopy, field emission scanning electron microscopy, high-resolution transmission electron microscopy, and X-ray photoelectron spectroscopy analysis. The poly(hydroxamic acid) ligand was utilized for the sensing and removal of transition metal ions form aqueous solutions. The solution pH is found a key factor for the optical detection of metal ions, and the reflectance spectra of the [Cu-ligand]n+ complex were observed to be the highest absorbance 99.5% at pH?6. With the increase of Cu2+ ion concentration, the reflectance spectra were increased, and a broad peak at 705?nm indicated that the charge transfer (p-p transition) complex was formed. The adsorption capacity with copper was found to be superior, 320?mg?g-1, and adsorption capacities for other transition metal ions were also found to be good such as Fe3+, Mn2+, Co3+, Cr3+, Ni2+, and Zn2+ were 255, 260, 300, 280, 233, and 223?mg?g-1, respectively, at pH?6. The experimental data show that all metal ions fitted well with the pseudo-second-order rate equation. The sorption results of the transition metal ions onto ligand were well fitted with Langmuir isotherm model (R2?>?0.98), which implies the homogenous and monolayer character of poly(hydroxamic acid) ligand surface. Eleven cycles sorption/desorption process were applied to verify the reusability of this adsorbent. The investigation of sorption and extraction efficiency in each cycle indicated that this new type of adsorbent can be recycled in many cycles with no significant loss in its original detection and removal capability.