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Removal of hexavalent chromium from aqueous solution using polypyrrole-polyaniline nanofibers

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ABSTRACT

Polypyrrole-polyaniline (PPy-PANI) nanofibers as adsorbent of Cr(VI) were prepared without template via coupling of propagating PPy+ and PANI+ free radicals by simultaneous polymerization of Py and ANI monomers in presence of FeCl3 oxidant. Inclusion of both polymeric moieties PPy and PANI in the fibers was confirmed by the Attenuated Total Reflectance Fourier transform infrared spectroscopy (ATR-FTIR). Entanglement and nanostructure of the PPy-PANI fibers were confirmed by field-emission scanning electron microscopy (FE-SEM) and high-resolution transmission electron microscopy (HR-TEM) respectively. Adsorption experiments were carried out in batch sorption mode to investigate the effect of pH, dose of adsorbent, contact time, concentration of Cr(VI) and temperature. The adsorption of Cr(VI) on the nanofibers surface was highly pH dependent and the kinetics of the adsorption followed the Pseudo-second-order model. The adsorption isotherm data fitted well to the Langmuir isothermal model. Thermodynamic parameters for the adsorption system were calculated and suggested that the adsorption process is spontaneous, endothermic and marked with an increase in randomness at the solid–liquid interface. The maximum adsorption capacity of the PPy-PANI nanofibers for Cr(VI) was 227 mg/g. Selective adsorption of Cr(VI) from aqueous solution was achieved in the presence of other co-existing ions. The nanofibers retained the original sorption capacity in the first two adsorption–desorption cycles of operation. The Cr(VI) uptake was mainly governed by a physico-chemical process, which included ion-exchange followed by reduction of Cr(VI) by electron rich polymer nanofibers to form Cr(III).