Nanochemistry and biotechnology

Preparation of single step amidoxime, carboxyl and amino groups containing resins for removal of environmental pollutants

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As reported earlier, surface features of the sorbent materials can clearly influence the selectivity and the adsorption capacity of sorbent. Much attention has been paid to improving the adsorptive performance of the sorbent, with the main effort being focused on the introduction of a functional group via grafting. Among the surface functionalization techniques, bifunctional group carrying molecules can be grafted on the material surface and then modified in to various functional groups by chemical reactions. For example, chloro groups on the acrylate monomers can be readily used for direct coupling of bifunctional molecules via nucleophilic substitution reaction.

In this study, magnetic poly(2-chloroethyl acrylate-co-ethylene glycol dimethacrylate), poly(CEA-co-EGDMA), beads were prepared via suspension polymerization, and the beads were then grafted with cyanamide, and nitrile groups of the grafted cyanamide were modified into amidoxime, carboxyl and amine groups with reaction of hydroxyl amine, HCl and $LiAlH_4$, respectively. The amidoxime, carboxyl and amine groups on poly(CEA-co-EGDMA) beads can act as adsorptive groups for organic molecules and heavy metal ions. ATR-FTIR spectroscopy, SEM, zeta-sizer analyses and analytical methods were used to characterize poly(CEA-co-EGDMA) and modified beads. The efficiency of the beads was investigated for uranium(VI) ions removal under a wide range of conditions such as: pH, temperature, equilibrium time and effect of initial concentration, and the experimental adsorption data tested with a number of theoretical kinetic and isotherm models. The maximum adsorption capacities of the pristine, amidoxime, carboxyl and amine modified beads at 25 °C were found to be 12.1, 365.6, 274.3 and 233.8 mg/g, respectively. Higher U(VI) ions adsorption capacity obtained with amidoxime modified beads may be due to the selective interaction of amidoxime groups specifically with uranium ions. It should be stated that the adsorption of U(VI) ion from aqueous solutions depends on the surface chemistry of the modified beads, and the affinity of U(VI) ion for the amidoxime is higher than those of the carboxyl and amine groups modified beads. Furthermore, it was expected that these modified beads would allow regeneration and repeated use in batch and/or a column processes.

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