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Synthesis of amidoximated polyacrylonitrile fibers and its application for sorption of aqueous uranyl ions under continuous flow

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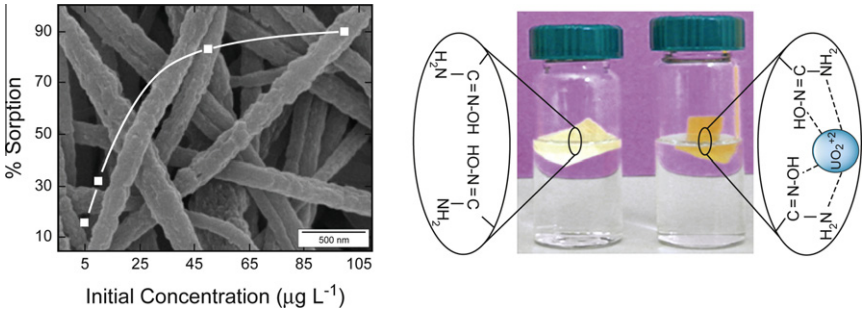
HIGHLIGHTS

- Submicron diameter PAN fibers were successfully prepared by electrospinning.
- PAN fiber mat was found to be promising in sorption of U(VI) ions by column method.
- The surface of PAN fibers were post-functionalized by amidoximation reaction.
- The surface modification remarkably enhanced U(VI) sorption capacity of PAN fibers.

GRAPHICAL ABSTRACT



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ABSTRACT

This study reports a feasible method for the removal of radioactive U(VI) ions from aqueous systems via column sorption under continuous flow. Electrospun polyacrylonitrile (PAN) fibers were used as sorbent materials in a homemade minicolumn. The nitrile groups on the fibers' surface were modified to amidoxime groups using hydroxylamine hydrochloride. Surface modification was observed to enhance the sorption capacity of PAN fibers toward uranium ions by more than 4-fold by virtue of the chelating ability of the amidoxime groups. The experiments investigated the effect of pH, initial concentration, and repetitive loading on the sorption properties of amidoximated PAN fibers. Based on the overall results, the surface-modified fibers seem to be a suitable potential sorbent material for applications in environmental cleanup, particularly for nuclear plants.

1. Introduction

Uranium is the heaviest naturally occurring radionuclide and has various harmful fouling effects in the environment. There are hundreds of uranium species, which account for 5% of all known minerals [1]. This element is present in most rocks, soil, surface water, and groundwater in the order of a few parts per million. It is also discharged into the environment from many anthropogenic activities such as mining, military applications, production and use of phosphate fertilizers, combustion from coal and other fuels, and nuclear power facilities. The increasing usage of nuclear reactors for large-scale energy production leads to radioactive contamination; hence, research concerning the separation of U(VI) ions from water has become a critical environmental issue in the last decade [2–4].

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