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Project Title
Synthesis and Characterization of Templated Ion Exchange Resins for the Selective Complexation of Actinide Ions

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Progress Report

RESEARCH OBJECTIVE

The purpose of this research is to develop polymeric extractants for the selective complexation of uranyl ions (and subsequently other actinyl and actinide ions) from aqueous solutions. Selectivity for a specific actinide ion is obtained by providing the polymers with cavities lined with complexing ligands so arranged as to match the charge, coordination number, coordination geometry, and size of the actinide ion. These cavity-containing polymers are produced by using a specific actinide ion (or surrogate) as a template around which monomeric complexing ligands are polymerized. The polymers provide useful sequestering agents for removing actinide ions from wastes and will form the basis for a variety of analytical techniques for actinide determination.

RESEARCH PROGRESS AND IMPLICATIONS

This report summarizes the first thirty months of a three year project. During this period the majority of the polymers tested were synthesized using three coordinating ligand monomers: vinyl benzoic acid, vinyl salicylaldehyde and vinyl salicylaldoxime. Polymers have been applied to sequestration, ion selective electrodes and just recently the production of a selectively permeable membrane. A quantity of the above polymer composition has been applied to sequestration and preconcentration of uranyl from a complex matrix (seawater). The experiment was performed to see if the resin was capable of removing small amounts of uranium in a mixture of a wide variety of other metals ions, prior to determination by UV-VIS spectrophotometry. Several polymer formulations have been incorporated into membranes and tested as ion selective electrodes.

The formula used to make uranyl ion selective electrodes has been modified to extend the operational lifetime from weeks to months. The variables in the optimization of the electrode performance include: 1) adjusting polymer formulations, 2) varying the plasticizers and their relative amounts in the formulations, and 3) changing membrane compositions. The copolymers made with vinyl salicylaldoxime exhibit better selectivity than those prepared with vinyl benzoic acid. The calibration plots show that the response of the vinyl salicylaldoxime membranes to high levels of interfering ions is less than the response to uranyl ion at the detection limit. Attempts to make a composite membrane for the electrode has met limited success. The response of the composite membrane gave a lesser calibration slope and was erratic. The problems with the composite membrane stem from too great a thickness for conductivity.

PLANNED ACTIVITIES

The uranyl ion sequestering agent will be optimized and tested against a broader range of interferences. Levels of crosslinking will be carefully evaluated in order to better understand the abrupt changes in selectivity. The ion selective electrode work will continue with the goal of fabricating membranes without using a PVC matrix. Plasticizer and ionophore will be added directly to the mixture of metal-ligand complex and spin-coated after the polymerization has been initiated in order to achieve appropriate thicknesses. The selective ion permeating membrane will also be fabricated by the spin coating method to effect a higher uranyl throughput. The luminescent uranyl compounds will be used to construct optical sensors.

INFORMATION ACCESS

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