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Preparation of High Purity, High Molecular-Weight Chitin from Ionic Liquids for Use as an Adsorbate for the Extraction of Uranium from Seawater

(Workscope MS-FC: Fuel Cycle R&D)

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ABSTRACT

Ensuring a domestic supply of uranium is a key issue facing the wider implementation of nuclear power. Uranium is mostly mined in Kazakhstan, Australia, and Canada, and there are few high-grade uranium reserves left worldwide. Therefore, one of the most appealing potential sources of uranium is the vast quantity dissolved in the oceans (estimated to be 4.4 billion tons worldwide). There have been research efforts centered on finding a means to extract uranium from seawater for decades, but so far none have resulted in an economically viable product, due in part to the fact that the materials that have been successfully demonstrated to date are too costly (in terms of money and energy) to produce on the necessary scale.

Ionic Liquids (salts which melt below 100 ^{o}C) can completely dissolve raw crustacean shells, leading to recovery of a high purity, high molecular weight chitin powder and to fibers and films which can be spun directly from the extract solution suggesting that continuous processing might be feasible. The work proposed here will utilize the unprecedented control this makes possible over the chitin fiber a) to prepare electrospun nanofibers of very high surface area and in specific architectures, b) to modify the fiber surfaces chemically with selective extractant capacity, and c) to demonstrate their utility in the direct extraction and recovery of uranium from seawater. This approach will 1) provide direct extraction of chitin from shellfish waste thus saving energy over the current industrial process for obtaining chitin; 2) allow continuous processing of nanofibers for very high surface area fibers in an economical operation; 3) provide a unique high molecular weight chitin not available from the current industrial process leading to stronger, more durable fibers; and 4) allow easy chemical modification of the large surface areas of the fibers for appending uranyl selective functionality providing selectivity and ease of stripping. The resulting sorbent should prove economically feasible, as well as providing an overall net energy gain.