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Novel solid-phase extractants for radionuclide preconcentration

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Preconcentration of radionuclides is a necessary stage for their accurate determination in aqueous natural and technological solutions. Sorption methods are the most perspective for selective recovery and separation of radionuclides from other elements. Various sorption materials containing complexing groups have been widely applied due to their selectivity and high degree of recovery. It is especially important for radionuclide preconcentration from high salinity nitric acid solutions generated under the reprocessing of spent nuclear materials.
The solid-phase extractants have gained considerable attention for preconcentration of trace elements. Special interest is given to the solid-phase extractants prepared by non-covalent immobilization of ligands on the surface of solid supports. For actinide and lanthanide preconcentration some organophosphorus and other ligands (tri-n-butylphosphate, carbamoylmethylphosphine oxide, malonamides, amines, macrocyclic compounds, etc.) have been widely used. These reagents are usually immobilized on silica-based matrices, polystyrene and polyacrylate polymers and other supports.
In the present work we used ionic liquids and various ligands as reagents for immobilization and the most perspective solid supports to prepare the novel solid-phase extractants designed for radionuclide preconcentration.
The ability of ionic liquids to be kept on solid surfaces and to reveal ion-exchange and complexing properties makes possible the synthesis of novel type solid-phase extractants. We prepared the solid-phase extractants by the non-covalent immobilization of tetraalkyl phosphonium and 1-alkyl-3-methyl imidazolium ionic liquids with different anions and studied their sorption properties. The matrices with large surface and high sorption ability were chosen as supports: multi-walled carbon nanotubes, highly cross-linked polystyrene, Amberlite XAD-7 and polyacrylonitrile fiber. The conditions of ionic liquid immobilization and radionuclide recovery were determined. The application of prepared solid-phase extractants for preconcentration of actinides, rare earth elements and radiopalladium from 1-3M nitric acid solutions was demonstrated.
Special attention was being paid to the use of carbon nanotubes as a support for solid-phase extractant preparation. Carbon nanotubes have come under intense multidisciplinary study due to their unique physical and chemical properties, which make them attractive for myriad uses including radiochemistry. The features of nanostructure and large surface ensure high sorption ability of carbon nanotubes and the possibility for their modification. We prepared the solid-phase extractants on the base of multi-walled carbon nanotubes “Taunit” ® (Russia) modified with ionic liquids and various ligands. Experimental data have shown high efficiency of the novel solid-phase extractants for radionuclide preconcentration from nitric acid solutions.

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Reference:

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Primary authors: Prof. MYASOEDOVA, Galina (Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences); Ms MOKHODOEVA, Olga (Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences)

Co-authors: Prof. MYASOEDOV, Boris (Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences); Dr MOLOCHNIKOVA, Nadezhda (Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences)

Presenter: Ms MOKHODOEVA, Olga (Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences)

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