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Investigation of uranium sorption on materials prepared from tetra-n-butylorthotitanate using LSC and TRLFS

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Separation of uranium from natural and waste water is a problem, which has been studied for a long time. For such purpose, many organic and inorganic sorption materials have been proposed and titanium dioxide have shown quite promising results. The first aim of this study was to test and characterize sorption materials based on TiO2 prepared from tetra-n-butylorthotitanate (TBOT) in order to optimize their preparation. The second aim was to implement direct hydrolysis of TBOT in the solutions containing uranium as a method for uranium separation.

Sorption capacities of six prepared materials were deduced from their sorption isotherms with fixed uranium concentrations (10 mmol L-1) and variable values of V/m (50 –400 mL g-1). In the direct hydrolysis experiments, the uranium solutions of 20 and 0.05 mmol L-1 were used. After proper multistage separation, uranium in the samples was measured using liquid scintillation counting and time-resolved laser-induced fluorescence spectrometry which together covered the concentration range of uranium in the samples from tens nmol L-1 to hundredths of mol L-1. For three of the six studied materials, the uranium sorption was studied in more details.

In the following experiments, the option of direct hydrolysis of TBOT in the sample was tested. This fast way of uranium separation, which could be suitable for in situ separations, was investigated at various conditions. The results were then compared with the classic sorption method of contacting uranium solutions with pre-prepared, solid absorbers based on TiO2 at similar conditions. It was found that the method of direct hydrolysis in the sample is more efficient separation step than the classic sorption, but it fairly depends on the conditions of the procedure itself.

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