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Electrochemical behaviour of selected actinides and lanthanides in molten fluoride salts FLiNaK and FLiBe

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The presented work is focused on research of basic electrochemical properties of several actinides and lanthanides representing the fissile material and fission products in suitable molten fluoride melt. The general framework of this work is to study the electrochemical behaviour of systems relevant for possible future use in the Generation IV reactor concepts.

Results of cyclic voltammetry, chronopotentiometric and electrolytic experiments with uranium and several lanthanides in the LiF-NaF-KF (acronym FLINAK) are presented. Mechanisms of electrochemical reduction were investigated. Recorded reduction steps were investigated and described in terms of reversibility, number of exchanged electrons, diffusion coefficients etc. For the lanthanides, it seems impossible to reach solid deposit of studied lanthanide on the electrode. For uranium, deposition depending on electrode material and shape was studied with special attention given to its deposition on reactive (Ni) working electrode.

Beryllium based molten salts 7LiF-BeF2-ZrF4 and 7LiF-BeF2 were used as a carrier melts during Molten Salt Reactor Experiment and Molten Salt Breeder Reactor projects [1] and are considered as a key systems also for the future use. In the LiF-BeF2 melt (acronym FLIBE), the work was focused on research of uranium behaviour in the melt and the influence of its composition between two eutectic points of FLIBE (eutectic compositions of FLIBE melt are defined by molar ratio of BeF2 x=0.328 and x=0.531).

Also the general consequences of obtained data for the development of separation process are concluded.

[1] C. F. Baes, Journal of Nuclear Materials 51:149 (1974).

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