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Thermodynamics of La and U in Ga-Al eutectic alloy and the separation factor of U/La in fused system Me(Ga-Al)/3LiCl-2KCl

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Actinides recycling by separation and transmutation are considered worldwide as one of the most promising strategies for more efficient use of the nuclear fuel. The actinide – lanthanide separation efficiency can be estimated from the thermodynamic equilibrium constants and the activity coefficients. The formal standard potentials of $E^{*}_{Me(III)/Me}$ and $E^{**}_{Me(Ga-Al)}$ vs. Cl^{-}/Cl_2 reference electrode has been obtained by measuring the electromotive force of the galvanic cells at the temperature range 723-823 K by using potentiometry at zero current method on Autolab PGSTAT302N.The activity coefficients of solid β-La and γ-U in liquid Ga-Al metallic alloy were determined by expression:

$$\log \gamma_{\beta-La\,(Ga-Al)} = 3.7 - \frac{12465}{T} \pm 0.08 \quad (1)$$

$$\log \gamma_{\gamma-U(Ga-Al)} = 1.6 - \frac{4962}{T} \pm 0.07 \quad (2)$$

The efficiency of electrochemical separation of metals during electrolysis was characterized by separation factor. Equation for calculation of separation factor (θ) for metals M_1 (uranium) and M_2 (lanthanum) in eutectic Ga-Al alloy is the following:

$$\log \Theta = 0.8 + \frac{3393}{T} \pm 0.02 \quad (3)$$

As a result of the present work the activity coefficients of lanthanum and uranium were determined in Ga-Al eutectic alloys between 723 and 823 K. Separation factors of the couple U/La was calculated and showed the large values of this process. Analyzing the obtained data showed the perspective to use this system in future innovation method for recovery of nuclear waste.

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