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Abstract

This work presents the electrochemical properties of gadolinium(Gd), a significant rare earth element in spent nuclear fuel (SNF), in the LiCl-KCl eutectic. To explore thermodynamic properties of Gd at the liquid gallium(Ga) electrode, experiments were performed both on the inert tungsten(W) and liquid gallium(Ga) electrode at different temperatures in a range from 723 K to 823 K, which showed that the Gd metal can be oxidized to Gd(III) by exchanging of 3 electrons. Electrochemical techniques including cyclic voltammetry (CV), open circuit potential (OCP), potentiostatic electrolysis and galvanostatic electrolysis were utilized to detect the electrochemical behavior and evaluate standard apparent potential of the Gd(Ⅲ)/Gd couple, obtained $E^{*}_{Gd(\mathrm{III})/Gd} = -3.456 + 6.2\times10^{-4}T(\pm0.046)$ (V vs Cl_2/Cl^-). In addition, electromotive force and coulometric titration were employed to calculate the activity and activity coefficient of Gd in metal Ga. After calculation, the activity is 1.791×10^{-15} at 723 K and function of activity coefficient and temperature is $Lg\gamma$=3.485-10927/T (±0.0875).

Keywords: LiCl-KCl eutectic; Electrochemical properties; Gadolinium; Liquid Ga

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