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# Electrochemical properties of gadolinium on liquid gallium electrode in LiCl-KCl eutectic

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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  $E_{Gd(III)/Gd}^* = -3.456 + 6.2 \times 10^{-4} T (\pm 0.046) \text{ (V vs } Q_2/Q^-)$ . 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  $1.791 \times 10^{-15}$  at 723 K and function of activity coefficient and temperature is  $Lg\gamma = 3.485 - 10927/T (\pm 0.0875)$ .

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

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