

Electrical Conductance of Molten (LiCl-KCl)_{eut} With Components of Spent Nuclear Fuel

Alexander Salyulev, Alexei Potapov*, Vladimir Shishkin, and Yury Zaykov

Institute of High Temperature Electrochemistry, Ekaterinburg, Russia

*A.Potapov_50@mail.ru

Pyrochemistry is one of the most innovative approaches for spent nitride nuclear fuel reprocessing. The first stage of SNF reprocessing is its dissolution in the LiCl-KCl eutectic. As a result, complex multicomponent solutions are formed, the properties of which have not yet been adequately studied.

The aim of this work is to develop a model for the electrical conductivity of complex melts based on LiCl-KCl eutectic, containing the SNF components. This communication is a continuation of our work [1].

To achieve this goal, we measured the electrical conductivity of a number of quasi binary melts (LiCl-KCl)_{eut.}, containing CeCl₃, NdCl₃, UCl₃, as well as CsCl and CdCl₂, and some of 3-4 component (LiCl-KCl)_{eut.} - CeCl₃ - NdCl₃ - UCl₃ mixtures.

In the work a capillary quartz cell with platinum electrodes and the AC-bridge method at the input frequency of 10-75 kHz were used. The measurements over the entire concentration and in wide temperature (up to 800-950°C) ranges were carried out. The lowest temperature was 5-10 degrees below the liquidus of all compositions in order to fix the temperature of crystallization onset.

The electrical conductivity of all melts increases with temperature and decreases as the concentration of trichlorides increases. The specific electrical conductivity (κ , S/cm) of molten mixture of LiCl-KCl eutectic with CeCl₃ (890-1122 K, 50.8 mol.% CeCl₃) is exemplified below:

$$\kappa = -3.7858 + 6.8563 \cdot 10^{-3} \cdot T - 1.7911 \cdot 10^{-6} \cdot T^2 \quad (1)$$

For the mixtures under study the density was

estimated and the molar conductivity was calculated. In all molten (LiCl-KCl)_{eut.} - LnCl₃ mixtures studied the significant negative deviations (up to -70% in maximum) of molar conductivity from additive values were observed over the whole concentration range, indicating a strong complexation in the systems. The results obtained are analyzed in terms of coexistence and mutual competition of complexes, which are formed by Li⁺ and Cd²⁺, Ce³⁺, Nd³⁺, U³⁺ cations.

The data obtained are necessary for the proper organization of the respective production processes.

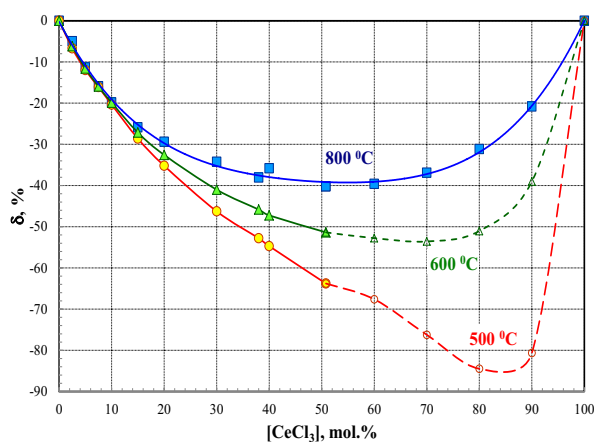


Fig. 1. Molar conductivity relative deviations from the additivity in the molten (LiCl-KCl)_{eut.} + CeCl₃ system.

Extrapolated values are shown in phantom.

REFERENCES

- [1] A. Salyulev, A. Potapov, V. Khokhlov, and V. Shishkin, "The electrical conductivity of model melts based on LiCl-KCl, used for the processing of spent nuclear fuel", *Electrochimica Acta*, 257, 510-515 (2017).