Chemical Behavior of Europium Oxides in LiCl-KCl Eutectic Melt

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The electrochemical behavior of lanthanide oxides in molten alkaline chloride media is of great concern in pyrochemical processes for advanced nuclear fuel cycle. We have studied the solubilities of various lanthanide oxides in LiCl-KCl eutectic melt. In general, lanthanide oxides appeared to be insoluble/sparingly soluble in LiCl-KCl eutectic at 723 K. However, europium oxide exhibited an abnormal behavior in solubility and redox chemistry. The solubility of europium oxide was measured to be 1-2 order of magnitude higher than those of other lanthanide oxides. This abnormal solubility may be attributable to different electrochemical behavior of europium in the same experimental conditions. Most lanthanides ion exists as trivalent oxidation states. However, we observed divalent europium dissolved in LiCl-KCl molten salt by applying electron paramagnetic resonance(EPR) spectroscopy. (Figure 1)
With the aid of this spectroscopic tool, it was found that stable Eu(II) species was formed at 723 K under anaerobic conditions. However, other lanthanides existed as trivalent species in the same conditions. It seems that above mentioned unusual redox behavior of europium in LiCl-KCl eutectic melt are closely related to higher solubility in the same condition.

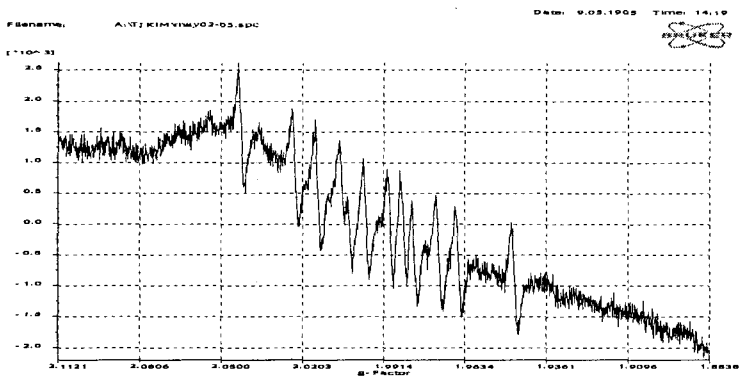

Figure 1. EPR spectrum of Eu(II) in LiCl-KCl matrix

EPR spectroscopy was useful for detecting Eu(II) species in molten salt matrix non-destructively, with high sensitivity.