Advancements Towards Molten Salt Spectroelectrochemistry

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Abstract:

Characterization of *f*-element chloride molten salt eutectics have been extensively studied by electrochemical methods but have not been widely investigated using spectroscopic techniques. Understanding the speciation of *f*-elements in these systems is necessary for the development of online monitoring techniques and spectroscopic techniques provide an immense advantage in this area. To effectively test whether spectroscopic data can be collected in tandem with electrochemical data a 3-D high temperature furnace has been constructed. The custom design enables simultaneous measurements using Raman and UV-Vis spectroscopy with electrochemical techniques. The electrochemical studies will provide diffusion coefficients that will provide insight into *f*-element aggregation in solution. These measurements coupled with UV-Vis or NIR spectroscopy, otherwise referred to as spectroelectrochemistry (SEC), will be used for the quantitative determination of *f*-element metal ion behavior useful for spectroelectrochemical sensor capabilities in used nuclear fuel pyroprocessing systems. Molten salt SEC is very challenging, so less complex aqueous systems at room temperature have been proposed as a proof of concept of the technique before moving onto more complicated systems. Lastly, Raman spectroscopy will be used in combination with electrochemical and UV-Vis measurements to probe the *f*-element coordination environment. Once proof of concept studies have been done and have successfully demonstrated the utility of the custom built furnace, the ultimate focus of this work will be on high metal loading conditions of selected lanthanides and uranium in a molten LiCl-KCl eutectic as well as on corrosion products (Fe, Cr) in an aqueous system. Initial studies of SEC on a known aqueous system and furnace construction with the implementation of electrochemical and spectroscopic techniques will be presented.