Effect of Metallic Li on the Behavior of Metals in Molten Salts

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ABSTRACT:

In order to integrate current stockpiles of used nuclear fuel into a pyroprocessing based fuel cycle, oxide fuel must be reduced to a metallic form. During the process of reducing uranium oxide, significant quantity of metallic lithium (Li^0) is generated and unless measures are taken to remove Li^0, Li^0 will accumulate in the molten LiCl-Li_2O electrolyte. While, the formation and accumulation of Li^0 in the molten salt electrolyte is well documented, the effect of so formed Li^0 on the degradation of the system materials has not been studied in detail. *Thus, there is a knowledge gap in understanding the effects of metallic lithium, present in the molten salt electrolyte, on materials. Specifically, the deleterious effect of Li^0 on the reactor container materials has not been studied.* Exposure to liquid Li^0 results in material degradation primarily through lithium intercalation, leaching of specific alloying elements, and decarburization. *The research objective of this proposal is to understand how the presence of Li^0 in molten LiCl-Li_2O affects the degradation of two classes of alloys by correlating their accelerated and long term electrochemical behavior to the surface chemistry of the alloys and the chemistry of the electrolyte.* These studies will focus on the role of Li^0 in altering the chemistry at the molten salt and material interface, and its resultant effects on oxide film stability and material longevity.

<u>Specific Objectives</u>: Specialized laboratory molten salt reactors with automated control and a suite of spectroscopic analytical techniques available in the PI's laboratory and the Co-PI's expertise AC/DC impedance methods uniquely qualify this team to execute the above study. Specific objectives include: (i) Electrochemical studies on materials in molten LiCl-Li_2O-Li^0, electrolyte, with varying Li_2O (0-8wt%) and Li^0 (0-1.0 mol%) concentrations (ii) Understanding of surface chemistry, (iii) Long term exposure studies, and (iv) Evaluation of surface mechanical properties. Quantification of these changes will help predict container material behavior and longevity more accurately.