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Fundamental and applied experimental investigations of corrosion of steel by LBE under controlled conditions: kinetics, chemistry, morphology, and surface preparation: quarterly report (October-December 2004)

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Introduction

This project has four components: (1) the fabrication of a materials test apparatus with unique capabilities, (2) comparative studies of steel corrosion under gas phase conditions comparable to the Lead Bismuth Eutectic (LBE) oxygen control conditions, (3) isotope labeling studies, and (4) collaborative efforts with other workers in the field.

(1) Materials test apparatus

We have issued a PO for the physical renovation of the laboratory (after which we can locate major pieces of the instrumentation in the space). Purchase orders for facility furnishing has been started.

We have a health and safety plan approved, and will obtain planning for power and ventilation upgrades to the facility. This is a major hurdle, since it involved baseline measurements of lead release during sample preparation and review of the regulatory constraints of the facility.

We are sending drawings out for bid and purchasing items for the test facility. The furnace sections have been placed into the lower section of the test facility.

(2) Comparative gas phase studies

Thermal uniformity issues in our tube furnace were discovered and remedied.

Tube furnace experiments are planned. We will do Knudsen cell experiments until the experimental space becomes available and the OCS system is relocated.

(3) Isotope labeling studies

Isotope labeling can be used to measure diffusion of materials under realistic conditions.

We have found appropriate conditions for our electropolishing experiments, and have made plans with Dr. Gaspar of Environmental Molecular Sciences Laboratory (EMSL) in Richland WA to do the SIMS (secondary ion mass spectrometry) and NRA (nuclear reaction analysis) of the O^{18} label.

Ion implantation studies will be initiated when appropriate.

(4) Collaborative work
A major effort has been underway to aid efforts at LANL and INEL.

We have mounted, prepared, and analyzed several tens of samples for LANL. The data analysis of the samples is in process – several of the samples show very low levels of corrosion, as hoped.

The collaboration with Dr. Eric Loewen (INEL) entered final write up stage after some final experiments in November. We are currently working on the draft of the journal submission.

Other program activities:

We are investigating the use of other UNLV facilities (XRD, Raman) in our work.

One of our students (Thao Ho) presented his work at a departmental seminar and has been accepted into the PhD program.

Abstract submitted: "Application of X-ray photoelectron spectroscopy to the study of the lead-bismuth eutectic (LBE)-induced corrosion of stainless steel", D. L. Perry(1), J. W. Farley(2), A. L. Johnson(3), D. Koury(2), B. Hosterman(2), U. Younas(2), and Thao Ho(3). (1) Lawrence Berkeley National Laboratory, Berkeley, CA 94720, (2) Department of Physics, University of Nevada, Las Vegas, NV 89154, (3) Department of Chemistry, University of Nevada, Las Vegas, NV 89154. To be presented on March 13, 2005, at the National Meeting of the American Chemical Society. San Diego, CA.