11-26-2001

Environment-Induced Degradation and Crack-Growth Studies of Candidate Target Materials: AAA Task-4 Quarterly (September 1 – November 30, 2001) Report

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Task 4. Second Quarter Report

MEMORANDUM

To: Drs. Anthony Hechanova and Gary Cerefice, HRC
From: Drs. Ajit Roy and Brendan O'Toole, MEG
Date: November 26, 2001
Subject: AAA Task-4 Quarterly (9/1 – 11/30, 2001) Report

Introduction

The primary objective of this task is to evaluate the effect of hydrogen on environment-assisted cracking of candidate materials for applications in spallation-neutron-target (SNT) systems such as accelerator production of tritium (APT) and accelerator transmutation of waste (ATW). The materials selected for evaluation and characterization are martensitic stainless steels including HT-9, EP 823 and 422. The susceptibility to stress corrosion cracking (SCC) and hydrogen embrittlement (HE) of these alloys will be evaluated in environments of interest using tensile specimens under constant load and slow-strain-rate (SSR) conditions. The extent and morphology of cracking of these alloys will further be evaluated by optical microscopy and scanning electron microscopy (SEM). The concentration of hydrogen resulting from cathodic charging will be analyzed by secondary ion mass spectrometry (SIMS).

Personnel

The current project participants are listed below.

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Highlights of Accomplishment

- Several expenditure request forms have been prepared and submitted to procure the following equipment to develop infrastructures for performing the planned experimental work in the proposed "Materials Performance Laboratory" to be located in room #B129 at the Engineering Building.

  - One eight-channel multipotentiostat (estimated cost per quote: $35,0000)
  - Six proof-ring assemblies, one high-temperature autoclave assembly, one each six-channel timer and temperature controller, and twelve electrochemical Lugin probe assemblies (total estimated cost per quotes: $68,000)
  - One high-temperature-inert-gas chamber with extension rod assembly and related system software for mechanical testing (total cost per quotes: $47,000)
  - One abrasive cutter for metallurgical sample preparation (cost per quote: $8,400)
  - One inverted optical microscope with associated parts for metallography (cost per quote: $18,000)

- Seven experimental heats of Alloys HT-9 (2), EP 823 (3) and 422 (2) have been melted. These ingots are currently being processed by hot working to convert them into bars at the vendor's facility, and will subsequently be shipped to UNLV for thermal treatments and specimen machining.

- A plan to establish a materials performance user facility (B#129) has been developed and presented to the appropriate authorities for approval. This facility will have capabilities to conduct thermal treatments, metallographic evaluation, sample preparation, mechanical testing, along with corrosion studies (SCC/HE/Electrochemical Polarization etc.) involving numerous aqueous environments of interest both at elevated and ambient temperatures. This facility will house some recently procured equipment using YM funding, some existing equipment, and future equipment (infrastructure) being purchased by AAA funding, as indicated above.

- Meanwhile, two interim testing facilities have been established at the Harry Reid Center (HRC #415) and Engineering Building (B#113). Constant load SCC tests are in progress at the HRC laboratory using four calibrated proof rings purchased with YM funding. Simultaneously, efforts are ongoing at B#113 to perform SCC tests using SSR/load-cell assemblies bought with YM funding.

- Finally, an undergraduate student is being selected to assist in future experimental work.

Problems

Assuming that the proposed "AAA-Materials Performance Laboratory" is going to be located at B#129 in the Engineering Building, no problems are currently anticipated.

Status of Funds

Expenditures incurred during this quarter are within the target amount allocated.

Plans for Next Quarter

- Set up the final AAA-materials laboratory, if approved, according to the planned layout using the currently available equipment from both HRC #415 and B#113.
- Prepare test matrices using materials from all seven experimental heats currently being processed.
- Heat treat test materials, machine them, and prepare the desired number of test specimens.
- Initiate SCC/HE/electrochemical polarization testing in the final laboratory.