



Damage Analysis and Fundamental Studies

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| <i>Irradiations were performed for a total of twenty-nine different experimenters during this quarter.</i> | |
| <i>A JOEL 200 CX TEM and associated darkroom equipment have been installed.</i> | |
| <i>The last of the present inventory of 50-em targets was consumed. Performance of these targets was as expected. Conversion to 23-em targets was accomplished in August.</i> | |
| <i>The second meeting of the U.S./Japan RTNS-II Steering Committee is now scheduled for February 1983.</i> | |
| | |
| 2. <u>Dual-Temperature Vacuum-Insulated Furnace System (HEDL)</u> | 10 |
| <i>A new Dual-Temperature Vacuum-Insulated (DTV) furnace system is available for use at the RTNS-II facility. It permits simultaneous irradiation of specimens at two closely controlled temperatures, under high vacuum conditions, in the primary irradiation volume of RTNS-II.</i> | |
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| 1. <u>Fission Reactor Dosimetry (ANL)</u> | 27 |
| <i>Analysis of dosimetry from the ORR-MFE4A2 and HFIR-CTR 31, 34, and 35 irradiations is in progress, and dosimeters have been prepared for several new experiments in HFIR. A computerized</i> | |

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dosimetry and damage data file has been initiated. The status of all dosimetry experiments is summarized.

2. Experiments at the IPNS Spallation Neutron Source (ANL) 31

Doses for organic insulators irradiated by LANL at the IPNS on February 22-27, 1982, ranged from 1.04 to 2.87×10^8 Rads depending on the compositions of the materials.

3. Helium Production in ${}^6\text{Li}$ and ${}^{10}\text{B}$ from ORR-TRIO (RIES) 36

Helium production measurements have been completed for the ${}^6\text{Li}$ and ${}^{10}\text{B}$ dosimeters irradiated in the Oak Ridge Research Reactor (ORR) as part of the ANL-ORNL TRIO experiment. The inferred tritium production rate from ${}^6\text{Li}$ agrees within uncertainties with ORNL's tritium production measurement.

CHAPTER 3: FUNDAMENTAL MECHANICAL BEHAVIOR 41

1. Developments in Small-scale Strength and Impact Testing (UCSB) 43

This report updates the developments of two test techniques, namely shear punch testing and miniaturized impact specimen testing. In shear punch testing, a very strong correlation has been found, for a wide range of materials, between the yield load exhibited during shear and the uniaxial tensile yield strength, and between the ~~maximum~~ load in shear and the ultimate tensile strength. In miniaturized impact testing, one-third size Charpy V-notch (CVN) specimens appear useful for tracking transition temperature shift and perhaps upper shelf energy changes.

2. Fundamental Flow and Fracture Analysis of Prime Candidate Alloy (PCA) for Path A (Austenitics) (UCSB and ORNL) 54
- Room temperature microhardness tests on samples of Prime Candidate Alloy (PCA) show that the thermomechanical treatment can significantly alter the microhardness of the PCA in a manner consistent with microstructural changes. Comparison measurements were made on several heats of 316 SS.*
3. Effect of Helium Irradiation on Fracture Modes (U. of Virginia) 72
- In-situ HVEM tensile testing of 316 SS irradiated with 80 keV helium ions was performed. Most cracks were mixed mode I and II. However, between 250°C and room temperature the effect of helium irradiation is to increase the amount of mode I crack propagation.*
4. The Development of Anisotropic Distributions of Network Dislocation Burgers Vectors in Alloys Irradiated Under Stress (HEDL and U. of Florida) 81
- When stress is applied to a metal during high temperature irradiation, both the Frank loops and the network dislocation products develop an anisotropy in the distribution of Burgers vectors.*
- One consequence of the anisotropy of network dislocations may be the loss at high fluence of the microstructural record of the stress state expressed in the distribution of the Frank loops on the various close-packed planes.*
5. Acceleration of Irradiation Creep with Fluence: Absence of a Definitive Microstructural Record (HEDL and U. of Wisconsin) 101
- A model has been developed to explain how the network dislocation density and the Frank loop density can be relatively*

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| <i>insensitive to changes in matrix chemistry while the creep rate can be changed substantially.</i> | |
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| 1. <u>Microstructural and Microchemical Comparisons of AISI 316 Irradiated in HFIR and EBR-II (HEDL)</u> | 115 |
| <i>Helium influences the cavity density but not the dislocation density or the microchemical evolution of the matrix in AISI 316. At least in the range 500–720°C, the attainment of steady-state swelling appears to be governed primarily by the rate of microchemical evolution of the alloy matrix and only secondarily by the He/dpa ratio.</i> | |
| 2. <u>Influence of Helium Injection Schedule and Prior Thermo-Mechanical Treatment on the Microstructure of Ion-Irradiated Type 316 Stainless Steel (ANL)</u> | 151 |
| <i>Hot preinjection of helium in 20% CW 316 followed by single-ion irradiation produced greater swelling than dual-ion irradiation; the opposite result was observed in annealed material. Hot-ion irradiation to 25 dpa produced very small cavities in 20% CW material, but a bimodal distribution in annealed material. Dislocation densities changed rapidly up to 5 dpa, saturating at ~25 dpa.</i> | |
| 3. <u>Correlation of Charged Particle and Neutron-Induced Radiation Damage: The ADIP Experiment Revisited (HEDL)</u> | 167 |
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| <i>a related phenomenon exerts a pronounced influence on ion-induced swelling. This must be considered in the conduct and interpretation of ion irradiation experiments employed to study the effect of helium or composition on swelling.</i> | |
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