# AEC-NASA TECH BRIEF



## Resistivity Measurements of Neutron-Irradiated Pure Metals and Al–Zn Alloys

A study was initiated to determine the source of the initial electrical-resistivity rise during neutron irradiation of metals and to determine the induced resistivity produced by a fission-neutron spectrum. A report has been prepared which presents resistivity measurements and their interpretation for neutron-irradiated pure metals and Al–Zn alloys. The influence of temperature, the role of point defects, and the aging behavior on resistivity are considered. The experimental procedures and results are discussed in detail.

To determine the resistivity rise in pure metals, Al, Cu, Ag, Au, Pt, Pd, Fe, and Ni were irradiated at 4.5°K in the Argonne CP-5 VT-53 cryogenic facility. The initial resistivity increase that occurs in low-temperature neutron irradiation of metals is thermal and appears to be due to gamma-ray heating. The irradiation-induced resistivity $\rho_i = A(1 - e^{-\alpha t}) + B(1 - e^{-\beta t})$, where A, B, $\alpha$, and $\beta$ are experimentally determined parameters for each metal. The first term is attributed to the production of displacement cascades, and the second to stable defect clusters or dislocation loops produced by interaction of the cascades. The irradiation effects in this VT-53 facility are due to fission neutrons, the damage rate being 13 times that of the ORNL Hole 12 facility and one-fifth that of the Munich FRM facility.

Aluminum and the alloys Al–1.70, Al-3.41, and 5.27 a/o Zn, in the quenched state and in the reverted state, were irradiated and isochronally annealed to study the effects of irradiation-induced lattice defects on the formation of Guinier–Preston (G.P.) zones. The damage rate for the aluminum and the alloys was the same, indicating that no G.P. zones formed during irradiation.

Irradiation greatly enhanced zone formation, especially in the reverted case, and the temperature of the start of zone formation and the resistivity maximum was a function of defect concentration. These results suggest that the formation and growth of the G.P. zones in aluminum–zinc alloys are controlled by the point-defect concentration.

**Notes:**

1. Additional details are contained in *Neutron Irradiation of Pure Metals and Aluminum–Zinc Alloys*, by James A. Horak, ANL-7185, October 1966, Argonne National Laboratory, Argonne, Illinois 60439. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; price: $3.00; microfiche $0.65.
2. This information may be of interest to fabricators and users of aluminum, metallurgical research laboratories, and to nuclear industries using pure metal or age-hardening alloys.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10200

Source: J. A. Horak,
Metallurgy Division
(ARG-10108)

**Patent status:**

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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Category 03