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December 1, 1959 COPY 1 OF 1, SERIES MA

POST IRRADIATION EXAMINATION OF A URANIUM

SWELLING CAPSULE, PT-IP-200-A (RM-257)

by

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POST IRRADIATION EXAMINATION OF A URANIUM
SWELLING CAPSULE, PT-IP-200-A (RM-257)

INTRODUCTION

A 1.6% enriched uranium rod, .570 inches in diameter and 4 inches in length, clad with .030 inch thick wall Zr-2 tubing by coextrusion, was irradiated in 105 DR to a calculated exposure of 450 MWD/T. The rod was irradiated in a NaK filled aluminum capsule and was temperature monitored by a thermocouple inserted through a swage lock into a recess drilled into the end of the rod. An A2-0.08%Co flux monitor was attached to the outer surface along the length of the rod. The capsule was discharged in early November 1958 and examination was begun in the Radiometallurgy Laboratory in January 1959.

References: HW-56132, HW-56589, HW-57109, SK-3-7936 and H-3-5960.

SUMMARY AND CONCLUSIONS

The NaK in the capsule was trapped in the expansion chambers leaving a portion of the fuel rod uncovered which caused gross heating on one side of the rod. A failure of the fuel rod resulted, and because of the uncertainties introduced, the data desired from this irradiation was not obtained.

No corrosion of the interior surface of the aluminum capsule was observed.

Burnup analysis showed 0.0466 a/o U²³⁵ burnup. *? Should be total atom*

DETAILS

Visual examination of the rod after removal from the aluminum NaK capsule showed evidence of operation at high temperature. The Zr-2 cladding was obviously swelled and contained a crack approximately one and one-half inches long. The flux monitor was on the heated side. The crack in the Zr-2 rod coincided with the location of the flux monitor.

A section of the aluminum NaK capsule was cut longitudinally to expose the inner surface where it appeared that the maximum temperature existed. No corrosion was observed on the aluminum surface.

Two sections were removed for metallographic studies, (1) a one-half inch thick wafer three fourths of an inch from the end of the fuel rod, and (2) a one half inch thick wafer containing the termination of the thermocouple well. Visual examination of the sectioned fuel rod disclosed that the uranium was split from the core to the surface on the heated side and the split extended the full length of the rod.

Metallographic examination of the wafers after vacuum cathodic etching showed that the uranium had been heated into the gamma phase and that considerable diffusion occurred at the U-Zircaloy-2 interface on the heated side of the rod. The maximum temperature was located near the surface of the uranium and the fuel rod was heated more at the end opposite the thermocouple.

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A sample for burnup analysis was removed from the midpoint of the rod and submitted to Analytical Operation. The results were 0.466 a/o U235 burnup. 0.0466

A print of each of the negatives obtained from RM-257 has been sent to J. W. Weber, Fuel Element Design Operation, HLO. The original data may be seen in HWN-1797.

W. J. Gruber

W. J. Gruber, Engineer
Radiometallurgy Laboratory
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