HEDL--7450

DE84 013934

IRRADIATION OF COPPER ALLOYS IN FFTF

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May 23, 1984

A Contribution to Damage Analysis and Fundamental Studies Quarterly Progress Report, DOE/ER-0046/17.

HANFORD ENGINEERING DEVELOPMENT LABORATORY
Operated by Westinghouse Hanford Company, a subsidiary of Westinghouse Electric Corporation, under the Department of Energy Contract No. DE-AC06-76FF02170
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NOTICE

IRRADIATION OF COPPER ALLOYS IN FFTF

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1.0 Objective

The object of this effort is to provide data on the response of a high-conductivity, high-strength series of copper alloys to high fluence neutron irradiation and thereby predict their behavior in anticipated fusion environments.

2.0 Summary

Nine copper-base alloys in thirteen material conditions have been inserted into the MOTA-1B experiment for irradiation in FFTF at ~450°C. The alloy Ni-1.9Be is also included in this experiment, which includes both TEM disks and miniature tensile specimens.

3.0 Program

Title: Irradiation Effects Analysis (AKJ)
Principal Investigator: D. G. Doran
Affiliation: Hanford Engineering Development Laboratory

4.0 Relevant DAFS Program Plan Task/Subtask

II.C.1 Effect of Material Parameters on Microstructure

5.0 Accomplishments and Status

5.1 Introduction

The use of high-conductivity high-strength copper-base alloys is anticipated for use in operation of fusion devices, particularly in the magnets and high heat-flux components.

There is very little data available on the response of such alloys to high levels of neutron exposure, however. The temperature range of anticipated use is $\leq$500°C, with the major applications below 300°C.

An opportunity recently arose to include a series of copper-base alloys in the MOTA-1B experiment currently being irradiated in the Fast Flux Test Facility (FFTF). The lowest temperature available in this experiment is ~450°C due to the use of helium rather than sodium as a thermal conduction medium.. The experiment is targeted to reach four exposure levels: 15, 45, 105 and 150 dpa.

As shown in Table 1 there are nine copper alloys, some of which are in more than one starting material condition. Table 1 also shows that a high-conductivity high-strength Ni-1.9Be alloy and AISI 316 were included, the latter to provide a reference state for the experiment. There are three sets of specimens presently being irradiated, one targeted for each fluence level and the fourth set to be inserted at a later time. Each set contains 14 miniature tensile specimens whose electrical conductivities were measured before irradiation and 30 TEM disk specimens, the latter to be used for microscopy and material properties testing.

6.0 References

None

7.0 Future Work

Experiments targeted to irradiate copper-base alloys at lower temperatures are also being designed.

8.0 Publications

None

TABLE 1

CONTENTS OF COPPER-MOTA-1B EXPERIMENT

ALLOYS SUPPLIED BY INESCO

Material	Composition	Condition
Cu Ag	Cu - 0.1 Ag	CW
Cu Ag P	Cu - 0.5 Ag - .06 P - .08 Mg	CWA
Al-25	Cu - 0.25 Al_2O_3	CW, SA
MZC	Cu - 0.9Cr - 0.1Zr - 0.05 Mg	CWA
Cu Be Ni	Cu - 1.8Ni - 0.3 Be	CWA, SA&T
Cu Be	Cu - 2.0 Be	CWA, SA&T
Ni Be	Ni - 1.9 Be	CWA

ALLOYS SUPPLIED BY HEDL

Cu - 5% Ni	These alloys used in previous RTNS-II studies	CW
Cu - 5% Al		CW
Cu (99.999%)		CW, SA
AISI 316		CW

SA = Solution-annealed
CW = Cold-worked
CWA = Cold-worked and aged
T = Tempered

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