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DT FUSION NEUTRON IRRADIATION OF BPNL GRAPHITE

IRRADIATION CAPSULE, LLL NIOBIUM, AND

LLL SIC CRYSTALS

Susan C. MacLean

MASTER

February 23, 1976

Unclassified

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Prepared for U.S. Energy Research & Development Administration under contract No. W-7405-Eng-48.

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In November, 1975, Dr. Walter J. Gray of Battelle Pacific Northwest Laboratories (BPNL) shipped a pure aluminum capsule measuring approximately 53 mm in length to LLL for irradiation by the Rotating Target Neutron Source (RTNS). The graphite irradiation capsule, as it was called, contained graphite samples and graphite sample holders plus niobium dosimetry foils. The fluence requested for the front of the capsule was $1.4 - 2.0 \times 10^{17}$ neutrons/cm². Prior to the present irradiation period beginning January 28, 1976, the capsule had received a few hours of irradiation on December 15, 1975.

Dr. Ralph H. Condit of LLL requested further irradiation of three niobium sample foils. He is interested in measuring helium generation from (n, α) reactions. The samples had been punched from niobium received from Dr. Richard Reed of Oak Ridge National Laboratory. Two of the samples, Nb-494 and Nb-498, were from Nb(C)95 piece #5 with a residual resistance of 7296. Sample Nb-495 came from Nb(C)95 piece #1 with a residual resistance of 6618.

The 12 mm diameter niobium discs of approximately 0.127 mm in thickness had previously been irradiated during the period September 16-19, 1975. The three samples were stacked together between two 0.03 mm thick, 12 mm diameter, niobium dosimetry foils. The entire stack was centered on the front of the graphite irradiation capsule. A 0.140 mm

thick, 12 mm diameter niobium dosimetry foil was attached to the back of the capsule.

Dr. Condit also requested irradiation of two thin SiC crystals which had been supplied by Ralph M. Potter of General Electric's Lighting Research and Technical Services Operation. The crystals were wrapped together in aluminum foil and sandwiched between two 0.140 mm thick niobium dosimetry foils (12 mm in diameter). This sample package was taped to the back of the sample holder supporting the graphite irradiation capsule.

The order of stacking, beginning with the material nearest the neutron source, was as follows:

<u>Order</u>	<u>Material</u>
1	Nb-556
2	Nb-494
3	Nb-495
4	Nb-498
5	Nb-557
6	Graphite Irradiation Capsule
7	Nb-558
To the side	
8	Nb-559
9	SiC crystals in aluminum foil
10	Nb-560

The samples were centered with the neutron beam with the aid of an autoradiograph of the front of the sample holder after a few minutes of irradiation. The irradiation was carried out by the LLL E Division Accelerator Staff during the period of January 28 to 30, 1976. The neutron production was monitored continuously with a proton recoil counter and recorded every hour. The dose record is attached. The total beam-on time was 45.67 hours. An autoradiograph of the front of the

sample holder following the irradiation showed the centering of the samples to be within 1 mm of the center of the neutron beam.

The sample holder assembly was stored for a few days to allow for decay of short-lived isotopes. The graphite irradiation capsule was shipped back to BPNL. The SiC crystals were returned to R. Condit. The niobium samples and dosimetry foils were delivered to Ruth Anderson in the LLL Radiochemistry Division where she performed the gamma ray counting.

The average fluence of each foil was calculated using the method described in UCRL-51393, Rev. 1. However, the cross section used for the activation of the 10.16 day niobium isomer by 14.8 MeV neutrons was changed to 458 millibarns. The results were as follows:

<u>Dosimetry Foil</u>	<u>Fluence (neutrons/cm²)</u>
Nb-556	1.53×10^{17}
Nb-494	1.47×10^{17}
Nb-495	1.43×10^{17}
Nb-498	1.36×10^{17}
Nb-557	1.33×10^{17}
Nb-558	1.16×10^{15}
Nb-559	1.70×10^{16}
Nb-560	1.55×10^{16}

The estimated overall uncertainty of these results is $\pm 7.5\%$. The relative uncertainty between any two values is about $\pm 2\%$. The values given here represent average fluences over the volume of each dosimetry foil.

RTNS IRRADIATION OF JANUARY 28 TO 30, 1976

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Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy \$ ____*; Microfiche \$2.25

<u>*Pages</u>	<u>NTIS Selling Price</u>
1-50	\$4.00
51-150	\$5.45
151-325	\$7.60
326-500	\$10.60
501-1000	\$13.60

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