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DT FUSION NEUTRON IRRADIATION OF BNL SINGLE
CRYSTAL Al_2O_3 , ORNL MgO CRYSTAL, AND LASL
90° SAPPHIRE, 0° SAPPHIRE, SPINEL AND YAG

Unclassified

Susan C. MacLean

June 15, 1976

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In order to most efficiently utilize the LLL Rotating Target Neutron Source (RTNS) during the run beginning May 17, 1976, samples from several researcher were stacked together for the irradiation.

Dr. Roger W. Klaffky of Brookhaven National Laboratory (BNL) supplied nine samples of single crystal Al_2O_3 . He requested as high a fluence as practical between 10^{17} and 10^{18} neutrons/cm² on his first sample.

Seven of the Al_2O_3 samples were discs measuring approximately 16 mm in diameter and varying from 0.51 to 1.02 mm in thickness. Five of these samples contained platinum electrodes. The remaining two samples were aluminum foil packages containing two and three pieces of Al_2O_3 and measuring approximately 8 X 11 X 1.3 mm and 11 X 12 X 1.3 mm, respectively. The nine Al_2O_3 samples were stacked with ten niobium dosimetry foils, approximately 12 mm in diameter by 0.03 mm in thickness.

A magnesium oxide crystal, approximately 10 X 19 mm and 2.8 mm thick, was provided by Dr. Yok Chen of Oak Ridge National Laboratory (ORNL) for RTNS irradiation. He requested a fluence of $4-5 \times 10^{16}$ neutrons/cm². The crystal was designated MgO-19 and was wrapped in aluminum foil. MgO-19,

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with a niobium dosimetry foil (0.14 mm thick, 12 mm diameter) in back of it, was stacked behind the Al_2O_3 samples and 0.03 mm dosimetry foils.

Four sample discs for RTNS irradiation, 90° sapphire, 0° sapphire, spinel and YAG, came from Dr. James M. Bunch of Los Alamos Scientific Laboratory (LASL). He requested a fluence of about 2×10^{16} neutrons/cm². Both the 90° sapphire and the 0° sapphire samples measured approximately 25 mm in diameter and 0.5 mm in thickness. The spinel was approximately 29 mm in diameter and 0.4 mm thick and the YAG was about 29 mm in diameter and 0.5 mm in thickness. All were individually wrapped in aluminum foil and stacked with 0.14 mm thick, 12 mm diameter niobium dosimetry foils behind all the other samples.

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

<u>Order</u>	<u>Sample</u>
1	Nb-563
2	Al_2O_3 Sample 1, Pt electrodes, 0.51 mm thick
3	Nb-564
4	Al_2O_3 Sample 2, Al foil packet of 3 pieces
5	Nb-565
6	Al_2O_3 Sample 3, Pt electrodes, 0.51 mm thick
7	Nb-566
8	Al_2O_3 Sample 4, Al foil packet of 2 pieces
9	Nb-567
10	Al_2O_3 Sample 5, Pt electrodes, 0.76 mm thick
11	Nb-568
12	Al_2O_3 Sample 6, Pt electrodes, 0.76 mm thick

<u>Order</u>	<u>Sample</u>
13	Nb-569
14	Al ₂ O ₃ Sample 7, Pt electrodes, 1.02 mm thick
15	Nb-570
16	Al ₂ O ₃ Sample 8, 1.02 mm thick
17	Nb-571
18	Al ₂ O ₃ Sample 9, 1.02 mm thick
19	Nb-572
20	MgO-19 in Al foil
21	Nb-573
22	90° sapphire in Al foil
23	Nb-574
24	0° sapphire in Al foil
25	Nb-575
26	Spinel in Al foil
27	Nb-576
28	YAG in Al foil
29	Nb-577

An autoradiograph of the front of the sample holder made after a few minutes of irradiation, was used to center the samples with the center of the beam. The neutron irradiation was carried out by the LLL E Division Accelerator Staff during the period May 17 to 24, 1976. Neutron production was monitored continuously with a proton recoil counter and recorded each hour. The dose record is attached. The total beam-on time was 73.35 hours.

Following the irradiation, the sample holder was stored for several days to allow short-lived isotopes to decay. An autoradiograph of the front of the sample holder indicated that the centering had been excellent.

The Al_2O_3 samples were returned to Dr. Klaffky at BNL, and the 90° sapphire, 0° sapphire, spinel and YAG to Dr. Bunch at LASL. The MgO crystal was retained for further irradiation. The niobium dosimetry foils were delivered to Ruth Anderson in the LLL Radiochemistry Division. She carried out the gamma ray counting.

The average fluence of each dosimetry 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 isomer of niobium 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-563	1.23×10^{17}
Nb-564	1.05×10^{17}
Nb-565	7.79×10^{16}
Nb-566	6.89×10^{16}
Nb-567	5.31×10^{16}
Nb-568	4.70×10^{16}
Nb-569	3.97×10^{16}
Nb-570	3.40×10^{16}
Nb-571	2.92×10^{16}
Nb-572	2.54×10^{16}
Nb-573	1.75×10^{16}
Nb-574	1.60×10^{16}
Nb-575	1.48×10^{16}
Nb-576	1.36×10^{16}
Nb-577	1.26×10^{16}

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

RTNS IRRADIATION OF MAY 17 TO 24, 1976

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