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^DDT FUSION NEUTRON IRRADIATING OF AI GLASS INSULATOR SAMPLE

AT 800°C AND SLL FIBER OPTIC BUNDLES

UNCLASSIFIED

SUSAN C. MACLEAN

APRIL 23, 1975

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INSULATOR SAMPLE AT 800°C AND
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For most efficient utilization of the LLL Rotating Target Neutron Source (RTNS), samples from two experimenters were irradiated during the run starting March 4, 1975. Dr. Don W. Keefer of Atomics International Division of Rockwell International (AI) provided a glass insulator sample measuring approximately 0.45 inch in diameter. The sample was a Nb -1% Zr substrate upon which a glass coating consisting of SiO_2 , BaO , and Al_2O_3 was fired. The substrate was 0.03 inch thick, and the coating was approximately 0.003 inch thick. Dr. Keefer requested a temperature of 800°C for his sample during the irradiation.

Dr. Laurence M. Watkins of Sandia Livermore Laboratory (SLL) supplied six fiber optic bundles for room temperature irradiation. He requested a fluence of 10^{12} neutrons/ cm^2 for two of the bundles and as high as possible fluence on the four other fiber optic bundles.

For the high temperature irradiation, a two piece platinum capsule sample holder was outgassed at 850°C for 3-1/2 hours in a vacuum of 10^{-7} mm mercury. It was then slow-cooled. The glass insulator and two 1.25mil thick niobium dosimetry foils were loaded into the platinum capsule. The capsule was clamped between two copper heat sinks, evacuated to about 10mPa ($\sim 10^{-4}$ torr), and electron-beam welded shut by Fran Silva. Three B&S gauge, 28 gauge chromel-alumel thermocouples were spot-welded to the capsule by Tom Shell.

For heating during the irradiation, the capsule was inserted into an alumina insulator and attached to the infrared reflector furnace designed by Robert Hibbard, formerly of LLL. Essentially, this furnace consists of a tungsten-quartz-iodide lamp and an aluminum reflector in the shape of an ellipsoid of revolution (Research Inc. "Spot Heater"). The lamp is placed at one focus and the capsule at the other. The lamp power is supplied by an SCR device. This is controlled by a Leeds and Northrup CAT controller which monitors one of the chromel-alumel-thermocouples. This device was able to control the capsule temperature to within $\pm 5^\circ\text{C}$ of the set point during the irradiation. The temperature was controlled at 800°C with an absolute accuracy of $\pm 10^\circ\text{C}$ with the exception of a period of six minutes at the end of the fourth day of irradiation. During this time the temperature was accidentally allowed to reach 860°C.

The room temperature irradiation of the fiber optic bundles was possible at the same time as the high temperature run because the two bundles requiring 10^{12} neutrons/cm² were placed 8.6 feet from the neutron source. The four remaining bundles were wound in concentric circles and fastened to a ring of lucite for support. The diameters of the circles varied from 8-1/2 inches to 13 inches. The lucite ring was clamped to the front of the furnace apparatus for the high temperature run. Six niobium dosimetry foils (5 mils thick, 12mm diameter disks) were fastened to the concentric circles of fiber optic bundles. Three were on the smallest concentric circle and three were on the largest concentric circle. Three one-inch square, 5 mils thick, niobium foils were stacked together and fastened to the last two fiber optic bundles.

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

<u>Order</u>	<u>Sample</u>
1	platinum capsule front
2	Nb-284
3	glass insulator (glass toward source)
4	Nb-285
5	platinum capsule back
6	Nb-334
7	Nb-335
8	Nb-336

} Smallest Circle Diameter

<u>Order</u>	<u>Sample</u>
9	Nb-337
10	Nb-338
11	Nb-339
12	Four fiber optic bundles
13	Nb-340 a,b + c
14	Two fiber optic bundles

} Largest Circle Diameter

The irradiation was carried out by the LLL E Division Accelerator staff during the period March 4-10, 1975. Neutron production was monitored continuously with a proton recoil counter and recorded each hour. The dose record is attached. Total beam-on time was 74.90 hours.

The capsule was heated to 800°C and allowed to stabilize for about five minutes prior to beginning each irradiation shift. The heater was shut down about five minutes after the beam went off and the capsule was allowed to cool (except for the six minutes previously mentioned) to room temperature during the periods between shifts.

After irradiation, the fiber optic bundles were returned to L. Watkins. The activity was allowed to decay for several days before the capsule was opened by hand, shearing the welded bead from the capsule. The glass insulator sample was returned to D. Keefer. The niobium dosimetry foils were delivered to the LLL Radiochemistry Division where Ruth Anderson performed the gamma ray counting. The average fluence on each dosimetry foil was computed using the method described in UCRL 51393, Rev.1. However, the value used for the niobium cross section for activation of the 10.16 day

isomer was changed to 458 mbarns for 14.8 Mev neutrons. This number was used for the foils directly in line with the neutron source (Nb-284, Nb-285, and Nb-340 a,b,+c). Since the four front fiber optic bundles were around the outside of the neutron beam, the neutron energy there was 14.1 Mev. Therefore, a cross section of 465 mbarns was used for the remaining six niobium foils. Because the neutrons were coming across these six foils sidewise, self-absorption was also taken into account when calculating the fluences. The results were as follows:

<u>Dosimetry Foil Number</u>	<u>Fluence (Neutrons/Cm²)</u>
Nb-284	6.89×10^{16}
Nb-285	5.79×10^{16}
Nb-334	3.60×10^{14}
Nb-335	2.79×10^{14}
Nb-336	3.08×10^{14}
Nb-337	1.80×10^{14}
Nb-338	1.53×10^{14}
Nb-339	1.64×10^{14}
Nb-340 a,b,+c	8.85×10^{11}

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.

IRRADIATION OF MARCH 4-10, 1975

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