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DT Fusion Neutron Irradiation of ORNL Magnesium Oxide Crystal,
BNPL Molybdenum, LLL Copper Tensile Specimens,
LLL Machinable Glass Ceramic, and U.W./LLL High Purity Metallic Foils

Unclassified

Susan C. MacLean

December 18, 1974

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In order to most efficiently utilize the LLL Rotating Target Neutron Source (RTNS), samples from several experimenters were included for the irradiation beginning November 7, 1974.

Dr. Yok Chen of Oak Ridge National Laboratory (ORNL) requested a fluence of 10^{18} neutrons/cm² be accumulated on a magnesium oxide crystal designated MgO-8. Previous irradiation of this crystal had occurred on January 14-16, 1974, May 29-31, 1974, July 16-18, 1974, September 11, 1974, October 7-9, 1974, and October 25, 1974.

Dr. John L. Brimhall of Battelle Pacific Northwest Laboratories (BPNL) also wanted a larger fluence accumulated on his molybdenum samples. The molybdenum foils had been placed in a stainless steel washer for ease of handling and had been irradiated January 14-16, 1974, September 11, 1974, October 7-9, 1974, and October 25, 1974.

Sixteen copper tensile specimens were supplied by Drs. Jack B. Mitchell and Richard A. Van Konynenburg of LLL. The tensile specimens had been cut from Cominco American sheet copper and were previously irradiated July 8-15, 1974, and October 25, 1974.

Dr. Richard A. Van Konynenburg also provided a piece of Corning machinable glass ceramic for irradiation. The sample was a disc measuring approximately 0.5 inch in diameter and 0.015 inch thick.

Dr. Heinz Barschall of the University of Wisconsin (U.W.) and LLL had 13 high purity metallic foils that he wanted irradiated frequently over a long period of time in order to look for long-lived isotopes. The foils were enclosed in a stainless steel holder with 12 mm diameter niobium dosimetry foils at the front and back of the stack. Aluminum foils were used as spacers between the sample foils. The order of stacking, beginning with the foil nearest the neutron source, was aluminum, iron, tantalum, nickel, niobium, copper, tungsten, molybdenum, zirconium, tin, titanium, vanadium, and chromium.

The copper tensile specimens were stacked with niobium dosimetry foils of the same size and shape and put in two epoxy-fiberglass laminate sample holders. A third lucite sample holder held the stainless steel container with Dr. Barschall's foils. The remaining samples were stacked with niobium dosimetry discs of 12 mm diameter and attached to the back of sample holder A, flush with sample holder B. The order of stacking, beginning with the material nearest the neutron source, was as follows:

<u>Order</u>	<u>Sample Holder</u>	<u>Sample</u>	<u>Distance from Source</u>
1	A	Mylar	3 mm
2		Nb-189	
3		Cu-1417	
4		Nb-190	
5		Cu-1418	
6		Nb-191	
7		Cu-1419	
8		Nb-192	
9		Cu-1422	
10		Nb-193	
11		Cu-1423	
12		Nb-194	
13		Cu-1425	
14		Nb-195	
15		Cu-1427	
16		Nb-196	
17		Cu-1430	
18		Nb-197	
19		Cu-1431	
20		Nb-198	
21		Mylar	
22		MgO-8 wrapped in aluminum foil	
23		Nb-207	
24		Molybdenum in stainless steel washer	
25		Nb-208	
26		Corning Machinable Glass Ceramic	

<u>Order</u>	<u>Sample Holder</u>	<u>Sample</u>	<u>Distance from Source</u>
27		Mylar	13 mm
28		Nb-199	
29		Cu-1434	
30		Nb-200	
31		Cu-1435	
32		Nb-201	
33		Cu-1436	
34		Nb-202	
35		Cu-1437	
36	B	Nb-203	
37		Cu-1438	
38		Nb-204	
39		Cu-1440	
40		Nb-205	
41		Cu-1441	
42		Nb-206	
43		Mylar	
44		Nb-209	20 mm
45	C	Barschall's foils	
46		Nb-210	

The irradiation was performed by the LLL E Division Accelerator Staff during the period November 7 to 13, 1974. Beam centering was checked by autoradiograph of the front sample holder after a few minutes of irradiation. The centering appeared to be accurate to within about 1 mm. Neutron production was monitored continuously with a proton recoil counter and recorded each hour. The dose record is attached. Total beam-on time was 72.97 hours.

The sample holder assembly was removed and stored for several days to allow for decay of short-lived isotopes.

The samples, except for the Corning machinable glass ceramic, were retained for further irradiation. The tensile specimen shaped dosimetry foils were cut so that only the sections corresponding to the tensile

sample gauge sections were weighed. These, along with the other niobium dosimetry foils, were delivered to the LLL Radiochemistry Division. Ruth Anderson carried out the gamma ray counting of the dosimetry foils. The average fluence of each foil was calculated as described in UCRL-51393, Rev. 1. The results were as follows:

<u>Dosimetry Foil Number</u>	<u>Fluence (neutrons/cm³)</u>
Nb-189	1.12×10^{17}
Nb-190	9.22×10^{16}
Nb-191	7.79×10^{16}
Nb-192	6.71×10^{16}
Nb-193	5.85×10^{16}
Nb-194	5.11×10^{16}
Nb-195	4.52×10^{16}
Nb-196	3.98×10^{16}
Nb-197	3.52×10^{16}
Nb-198	3.20×10^{16}
Nb-207	2.50×10^{16}
Nb-208	2.32×10^{16}
Nb-199	1.90×10^{16}
Nb-200	1.75×10^{16}
Nb-201	1.61×10^{16}
Nb-202	1.48×10^{16}
Nb-203	1.38×10^{16}
Nb-204	1.26×10^{16}
Nb-205	1.18×10^{16}
Nb-206	1.10×10^{16}
Nb-209	8.39×10^{15}
Nb-210	6.29×10^{15}

The estimated overall uncertainty of the 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.

I C T IRRADIATION OF 11/7/74--11/13/74

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