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DT FUSION NEUTRON IRRADIATION OF LLL VANADIUM TENSILE SPECIMENS, BPNL
WIRE-FOIL PACKET, LLL Nb_3Sn TAPE, LLL CARBON RESISTOR, LLL GLASS SAMPLES,
AND LLL THERMOELECTRIC TEMPERATURE SENSORS

Unclassified

Susan C. MacLean

July 19, 1976

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In order to most efficiently utilize the LLL Rotating Target Neutron Source (RTNS) during the run beginning June 7, 1976, samples from several experimenters were stacked together for the irradiation.

Six MRC VP grade vanadium tensile specimens were supplied by Dr. Jack B. Mitchell of LLL. The samples measured approximately 28.6 mm long, 9.5 mm wide, and 0.5 mm thick with gauge sections about 6 mm in length and 1.6 mm in width. They had been annealed at 975°C for one hour. The tensile specimens were stacked in an epoxy-fiberglass laminate sample holder with 0.140 mm thick niobium dosimetry foils of the same size and shape.

Dr. Russell Jones of Battelle Pacific Northwest Laboratories (BPNL) requested irradiation of a wire-foil packet. On the front of the packet were 33 wires and/or tensile specimens about 45 mm long of niobium, nickel and stainless steel. These were backed by a foil approximately 25 mm square and all were supported on a 0.114 mm thick foil measuring 39x51 mm. In the back, the support foil had a 19 mm diameter hole in the center. Six parallel strips of foil could be seen through the hole,

held in place between the square foil and the support foil. A niobium dosimetry foil, 12 mm diameter by 0.140 mm thick, was centered on the front of the wire-foil packet over the wires and/or tensile specimens. The packet was then centered behind the vanadium tensile specimens and taped to the epoxy-fiberglass laminate sample holder.

Two samples were received from Dr. Ronald M. Scanlan of LLL, a carbon resistor and a piece of Nb_3Sn . The resistor, measuring approximately 4 mm in length and 1 mm in diameter, was backed by a niobium dosimetry foil (3x6x0.127 mm) and was centered on the lower front edge of the epoxy-fiberglass laminate sample holder. The Nb_3Sn tape (approximately 7x13x0.09 mm) was sandwiched between two niobium dosimetry foils (0.127 mm thick) of a similar size and shape before being centered on the back of the wire-foil packet.

A second sample holder (lucite) was used for the six thermoelectric temperature sensors and two glass samples received from Dr. Stuart R. Gunn of LLL. The exteriors of the thermoelectric temperature sensors were bromine oxide while the interiors were alloys of antimony, bismuth, and tin. Temperature sensors 103, between two niobium dosimetry foils (9x9x0.127 mm) was attached to the second sample holder so that it was centered behind the center of the first sample holder. The two glass samples, NG-1 and BG-18, each 12.7 mm in diameter, were stacked with a 12 mm diameter by 0.140 mm thick niobium foil in front of each and were centered on top of the temperature sensor 103.

Looking at the lucite sample holder from the direction of the neutrons, temperature sensor 108 was to the left of temperature sensor 103 (on a horizontal line through the center of both temperature sensors) and

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was also sandwiched between niobium foils (13x14x0.14 mm). The thermo-electric temperature sensors 104 and 105, each between niobium foils measuring approximately 8x13x0.127 mm, were placed to the right of temperature sensor 103 with sample 104 between 103 and 105. The long dimensions of 104 and 105 were parallel to 103 and perpendicular to the floor. Temperature sensors 110 and 112 were put between dosimetry foils (13x13x0.14 mm) and were attached to the lucite sample holder above and to the right of 103, and above and to the left of 103, respectively, as seen from the neutron source.

The lucite sample holder was put as close as possible behind the first sample holder. The order of stacking, beginning with the material nearest the neutron source, was as follows:

First sample holder

<u>Order</u>	<u>Material</u>
1	Nb-578
2	V -5951
3	Nb-579
4	V -5959
5	Nb-580
6	V -5970
7	Nb-581
8	V -5974
9	Nb-582
10	V -5983
11	Nb-583
12	V -5984

13	Nb-589	
14	Mylar spacers	
15	Nb-584	
16	Wire-foil packet	
17	Nb-585	
18	Nb ₃ Sn tape	
19	Nb-586	
20	Carbon resistor	} on lower front edge of sample holder
21	Nb-587	

Second sample holder

centered samples

<u>Order</u>	<u>Material</u>
22	Nb-590
23	Glass BG-18
24	Nb-591
25	Glass NG-1
26	Nb-592
27	Temperature sensor 103
28	Nb-593

Bracketed groups arranged side by side as described

29	{	Nb-594
30		Temperature sensor 104
31		Nb-595
32	{	Nb-596
33		Temperature sensor 105
34		Nb-597

35	{	Nb-598
36		Temperature sensor 108
37		Nb-599

38	{	Nb-600
39		Temperature sensor 110
40		Nb-603

41	{	Nb-602
42		Temperature sensor 112
43		Nb-601

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 neutron beam. The irradiation was carried out by the LLL E Division Accelerator Staff during the period June 7 to 17, 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 137.15 hours.

Following the irradiation, an autoradiograph of the front sample holder showed the centering error to have been less than 1 mm. The sample holders were stored for several days to allow short lived isotopes to decay.

The wire-foil packet was returned to Dr. Jones at BPNL. The carbon resistor and Nb₃Sn tape were returned to R. Scanlan as were the two glass samples and six temperature sensors to S. Gunn. The vanadium tensile specimens were retained for further irradiation.

The tensile specimen shaped dosimetry foils were cut and weighed so that only the portions corresponding to the tensile sample gauge sections would be counted. These along with the remaining niobium dosimetry foils were delivered to Ruth Anderson in the LLL Radiochemistry Division for 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-578	2.13×10^{17}
Nb-579	1.80×10^{17}
Nb-580	1.58×10^{17}
Nb-581	1.36×10^{17}
Nb-582	1.18×10^{17}
Nb-583	1.04×10^{17}
Nb-589	9.15×10^{16}
Nb-584	6.15×10^{16}
Nb-585	5.63×10^{16}
Nb-586	5.45×10^{16}
Nb-587	5.28×10^{16}
Nb-590	5.17×10^{16}
Nb-591	4.46×10^{16}
Nb-592	3.93×10^{16}
Nb-593	2.24×10^{16}
Nb-594	3.33×10^{16}

<u>Dosimetry Foil</u>	<u>Fluence (neutrons/cm²)</u>
Nb-595	1.91×10^{16}
Nb-596	2.17×10^{16}
Nb-597	1.38×10^{16}
Nb-598	2.80×10^{16}
Nb-599	1.73×10^{16}
Nb-600	2.15×10^{16}
Nb-603	1.51×10^{16}
Nb-602	2.27×10^{16}
Nb-601	1.53×10^{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 JUNE 7 TO 17, 1976

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