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DT FUSION NEUTRON IRRADIATION OF LLL 316 STAINLESS

STEEL AND SLL SILICA SAMPLES

S. C. MacLean

March 31, 1977

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DT FUSION NEUTRON IRRADIATION OF LLL 316 STAINLESS
STEEL AND SLL SILICA SAMPLES

ABSTRACT

The DT fusion neutron irradiation of six LLL 316 stainless steel samples and 24 SLL pure silica samples is described. The sample position, beam-on time, and neutron dose record are given. The maximum neutron fluence on any sample was 1.52×10^{17} neutrons/cm².

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DT FUSION NEUTRON IRRADIATION OF LLL 316 STAINLESS
STEEL AND SLL SILICA SAMPLES

Unclassified

October 13, 1976

Susan C. MacLean

Samples from Dr. Richard R. Vandervoort of LLL and Dr. John Vitko and Dr. Richard Gay of Sandia Livermore Laboratory (SLL) were combined for the Rotating Target Neutron Source (RTNS) irradiation starting September 7, 1976.

A fluence of 10^{18} neutrons/cm² was being accumulated on six stainless steel samples for R. R. Vandervoort. Four of the samples were tensile specimens with gauge sections measuring approximately 6 mm long, 1.6 mm wide, and 0.5 mm thick. The two remaining 316 stainless steel samples, P-3 and C-3, were tabs. P-3 measured approximately 8 × 4 × 0.5 mm and C-3 approximately 10 × 10 × 0.5 mm. The samples were stacked with 0.14 mm thick niobium dosimetry foils of the same size and shape as the samples. These six samples had been irradiated during the periods June 22 to 29, 1976 and July 8 to 21, 1976.

Twenty-four pure silica samples were received from J. Vitko and R. Gay. The samples had 100 ppm metallic aluminum and 1000 ppm OH. Each sample measured approximately 10 × 4 × 1 mm. The samples were evenly divided into six groups, with a different fluence requested for each group: 3×10^{16} n/cm², 10^{16} n/cm², 3×10^{15} n/cm², 10^{15} n/cm², 3×10^{14} n/cm², and 10^{14} n/cm².

Each group of silica samples was treated in the same manner. The samples were wrapped in aluminum foil, two samples side by side per packet, therefore two packets per group. The position of each sample was labeled on the outside of the packet. The sample packets were stacked together with two niobium dosimetry foils (measuring approximately 10 × 4 × 0.14 mm) between the sample packets. Two dosimetry foils were also on the front of the stack and two on the back.

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

<u>Order</u>	<u>Sample</u>	<u>Distance from Neutron Source</u>	
First sample holder			
1	Nb-643	3mm	
2	S.S. P-1		
3	Nb-644		
4	S.S. C-1		
5	Nb-645		
6	Nb-646		
7	S.S. P-3		
8	Nb-647		
9	Nb-648		
10	S.S. C-3		
11	Nb-649		
12	Nb-650		
13	S.S. P-2		
14	Nb-651		
15	S.S. C-2		
16	Nb-652		
17	Nb-670		Nb-671
18	Silica 195		Silica 295
19	Nb-672		Nb-673
20	Silica 395		Silica 495
21	Nb-674		Nb-675
Second sample holder			
22	Nb-676	Nb-677	21mm
23	Silica 194	Silica 495	
24	Nb-678	Nb-679	
25	Silica 394	Silica 494	
26	Nb-680	Nb-681	
Third sample holder			
27	Nb-682	Nb-683	41mm
28	Silica 193	Silica 393	
29	Nb-684	Nb-685	
30	Silica 393	Silica 493	

<u>Order</u>	<u>Sample</u>		<u>Distance from Neutron Source</u>
31	Nb-686	Nb-687	
Fourth sample holder			
32	Nb-688	Nb-689	
33	Silica 192	Silica 292	
34	Nb-690	Nb-691	72mm
35	Silica 392	Silica 492	
36	Nb-692	Nb-693	
Fifth sample holder			
37	Nb-694	Nb-695	
38	Silica 191	Silica 292	
39	Nb-696	Nb-697	131mm
40	Silica 391	Silica 491	
41	Nb-698	Nb-699	
42	Nb-700	Nb-701	
43	Silica 187	Silica 287	
44	Nb-702	Nb-703	227mm
45	Silica 387	Silica 487	
46	Nb-704	Nb-705	

A copper foil with a 6 mm diameter hole was centered on cross hairs on the back of the target and irradiated briefly. An autoradiograph of the copper foil showed the position of the neutron beam so that the samples could be aligned with it. The neutron irradiation was carried out by the LLL E Division Accelerator Staff during the period September 7 to 10, 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 58.47 hours.

Following the irradiation an autoradiograph of the front sample holder showed that the centering of the samples with the neutron beam had been within 1 mm. The sample holders were stored for several days to allow short-lived isotopes to decay. The stainless steel samples were retained for further irradiation. The silica samples were returned to SLL.

The tensile specimen shaped dosimetry foils were cut and weighed so that only the gauge sections would be used. These along with the other niobium

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-643	1.52×10^{17}
Nb-644	1.20×10^{17}
Nb-645	9.89×10^{16}
Nb-646	9.11×10^{16}
Nb-647	7.46×10^{16}
Nb-648	6.28×10^{16}
Nb-649	5.43×10^{16}
Nb-650	5.62×10^{16}
Nb-651	4.79×10^{16}
Nb-652	4.29×10^{16}
Nb-670	3.35×10^{16}
Nb-671	3.62×10^{16}
Nb-672	2.73×10^{16}
Nb-673	2.92×10^{16}
Nb-674	2.18×10^{16}
Nb-675	2.32×10^{16}
Nb-676	9.58×10^{15}
Nb-677	9.84×10^{15}
Nb-678	8.50×10^{15}
Nb-679	8.44×10^{15}
Nb-680	7.27×10^{15}
Nb-681	7.42×10^{15}
Nb-682	2.54×10^{15}
Nb-683	2.56×10^{15}
Nb-684	2.40×10^{15}
Nb-685	2.38×10^{15}
Nb-686	2.21×10^{15}
Nb-687	2.21×10^{15}

Dosimetry FoilFluence (neutrons/cm²)

Nb-688	8.51×10^{14}
Nb-689	8.50×10^{14}
Nb-690	8.22×10^{14}
Nb-691	8.18×10^{14}
Nb-692	7.80×10^{14}
Nb-693	7.72×10^{14}
Nb-694	2.49×10^{14}
Nb-695	2.48×10^{14}
Nb-696	2.40×10^{14}
Nb-697	2.43×10^{14}
Nb-698	2.34×10^{14}
Nb-699	2.34×10^{14}
Nb-700	8.24×10^{13}
Nb-701	8.15×10^{13}
Nb-702	8.10×10^{13}
Nb-703	8.00×10^{13}
Nb-704	7.85×10^{13}
Nb-705	7.88×10^{13}

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 SEPTEMBER 7 TO 10, 1976

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