27/
3-30-76
25 copy NTIS

UCID- 17076

Lawrence Livermore Laboratory

DT FUSION NEUTRON IRRADIATION OF BNL-LASL

SUPERCONDUCTOR WIRES, BPNL GRAPHITE

IRRADIATION CAPSULE, AND LLL KEVLAR 49

Susan C. MacLean

MASTER

January 8, 1976

Unclassified

This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the laboratory.

Prepared for U.S. Energy Research & Development Administration under contract No. W-7405-Eng-48.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DT FUSION NEUTRON IRRADIATION OF BNL-LASL
SUPERCONDUCTOR WIRES, BPNL GRAPHITE
IRRADIATION CAPSULE, AND LLL KEVLAR 49

Unclassified

January 8, 1976

Susan C. MacLean

In order to utilize the LLL Rotating Target Neutron Source (RTNS) most efficiently, samples from several experimenters were included for the irradiation to begin on December 15, 1975.

A fluence of 10^{18} neutrons/cm² was being accumulated on twelve superconductor wires from Dr. C. L. Snead, Jr. of Brookhaven National Laboratory (BNL) and Dr. Don M. Parkin of Los Alamos Scientific Laboratory (LASL). The wires had previously been irradiated July 31, 1975, August 18-22, 1975, August 26-29, 1975, September 16-19, 1975, and October 3-13, 1975. Prior to the present fluence accumulation, two of the superconductor wires, 19-core Nb₃Sn multi-filament, had received approximately 10^{18} neutrons/cm² from RTNS irradiations. The remaining superconductor samples were three pieces Nb₃Sn single core wire, three pieces V₃Ga single core wire, two pieces NbTi Supercon 402, and two pieces NbTi cupronickel jacketed wire.

The superconductor wires varied in length between 19 and 28 mm. They had all been packaged together in aluminum foil prior to their initial irradiation. The aluminum foil packet was sandwiched between two 12 mm diameter niobium dosimetry foils which were 0.03 mm thick.

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Dr. Walter J. Gray of Battelle Pacific Northwest Laboratories (BPNL) supplied a pure aluminum capsule containing graphite sample holders, graphite samples, and niobium dosimetry foils. He requested a fluence of at least 10^{17} neutrons/cm² at 1 mm back from the front surface of the capsule. The capsule measured approximately 53 mm long and 12 mm in diameter. It was held in a specially made synthane sample holder with a hole the size of the front of the capsule. Two set screws held the capsule in place, the front flush with the front of the sample holder. The superconductor wires, with the dosimetry foils, were centered on the sample holder over the front of the capsule. A 0.127 mm thick, 12 mm diameter niobium dosimetry foil was attached to the back of the capsule.

Dr. Lynns Penn of LLL provided four color coded groups containing six samples each of Kevlar 49 to be irradiated over a range of fluences. Each group of samples was arranged on one lucite sample holder, and all groups were arranged in the same manner. The samples were numbered from one to six. Left to right (as seen from the neutron source) across the bottom of the sample holder, samples 1, 2, 3 and 4 were placed parallel to each other and perpendicular to the floor. Sample 5 on the left and sample 6 on the right were put above the other samples, perpendicular to them, and parallel to the floor. The samples were threaded on fine wires and wired in place on the sample holders. The sample holders were spaced along a second rod at distances to span three orders of magnitude of neutron fluence with one week or irradiation.

Because the Kevlar 49 samples had to be irradiated completely in air, dosimetry foils were only placed on the back side of the samples. The orange

labeled samples each had a niobium dosimeter, measuring approximately 29 x 6.5 x 0.127 mm, centered behind them. The red labeled group had two 0.127 mm thick niobium dosimetry foils, approximately 25 mm square, stacked together and centered on the sample holder behind the Kevlar 49 bundles. The blue labeled samples had three niobium dosimetry foils similarly arranged and the pink group of samples had four of the square dosimetry foils.

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>
<u>First Rod</u>			
1.	A	{ Nb-536	3 mm
2.		Superconductor wires	
3.		{ Nb-537	
4.		BPNL Grpahite irradiation capsule	
5.		{ Nb-538	
<u>Second Rod</u>			
6.	Bracketed groups arranged side by side on sample holder	{ Kevlar 49-orange 1	55 mm
7.		{ Nb-539	
8.		{ Kevlar 49-orange 2	
9.		{ Nb-540	
10.		{ Kevlar 49-orange 3	
11.		{ Nb-541	
12.		{ Kevlar 49-orange 4	
13.		{ Nb-542	
14.		{ Kevlar 49-orange 5	
15.		{ Nb-543	
16.		{ Kevlar 49-orange 6	
17.		{ Nb-544	
18.	C	{ Kevlar 49 - red 1 through 6	180 mm
19.		{ Nb-545 A & B	
20.	D	{ Kevlar 49 - blue 1 through 6	568 mm
21.		{ Nb-546 A, B & C	
22.	E	{ Kevlar 49 - pink 1 through 6	803 mm
23.		{ Nb-547 A, B, C & D	

The irradiation was carried out by the LLL E Division Accelerator Staff on December 15, 1975. The 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 5.42 hours. The high voltage power supply went out and could not be repaired soon enough to conveniently continue the irradiation. The dosimetry foils were delivered to Ruth Anderson in the LLL Radiochemistry Division for gamma ray counting. Although they had not yet received the desired dose, the superconductor wires were shipped to Dr. Snead at BNL, because there would have been considerable delay before further irradiation of them. The Kevlar 49 samples were returned to L. Penn at LLL.

The BPNL graphite irradiation capsule was retained for further irradiation.

The average fluence of each niobium dosimetry foil was calculated using the method described in UCRL-51393, Rev. 1. However, the value used for the cross section for the activation of the 10.16 day niobium isomer 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-536	1.72×10^{16}
Nb-537	1.37×10^{16}
Nb-538	1.20×10^{14}
Nb-539	1.76×10^{14}
Nb-540	2.35×10^{14}
Nb-541	2.72×10^{14}
Nb-542	2.88×10^{14}
Nb-543	1.99×10^{14}
Nb-544	2.66×10^{14}
Nb-545 A & B	1.80×10^{13}
Nb-546 A, B, & C	1.39×10^{12}
Nb-547 A, B, C & D	6.26×10^{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.

RTNS IRRADIATION OF DECEMBER 15, 1975

29 DEC 75

09:54:49

INTERNAL DISTRIBUTION

J. D. Anderson, L-312
R. M. Anderson, L-231
R. Booth L-330
R. J. Borg, L-231
J. C. Davis, L-313
J. W. Frazer, L-401
C. Gatrousis, L-231
M. W. Guinan, L-233
C. M. Logan L-141
L. G. Mann, L-540
J. B. Mitchell, L-426
L. S. Penn, L-421
L. W. Roberts, L-401
R. R. Vandervoort, L-426
R. A. Van Konynenburg, L-233
C. Wong, L-313
S. C. MacLean L-233 (3)
TID, L-9 (15)

EXTERNAL DISTRIBUTION

Dr. Klaus Zwilsky, USERDA
Division of Controlled Thermonuclear
Research
Washington, D. C. 20545

Dr. Marvin Cohen, USERDA
Division of Controlled Thermonuclear
Research
Washington, D. C. 20545

EXTERNAL DISTRIBUTION (cont.)

Dr. Charles Finfgeld, USERDA
Division of Controlled Thermonuclear
Research
Washington, D. C. 20545

Dr. Louis Ianniello, USERDA
Division of Physical Research
Washington, D. C. 20545

Dr. Robert Heinrich
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Dr. T. C. Reuther, USERDA
Division of Controlled Thermonuclear
Research
Washington, D. C. 20545

Dr. C. L. Snead, Jr.
Brookhaven National Laboratory
Upton, Long Island, New York 11973

Dr. Don M. Parkin
Los Alamos Scientific Laboratory
P. O. Box 1663
Los Alamos, New Mexico 87544

Dr. Walter J. Gray
Battelle Pacific Northwest Laboratory
Ceramics & Graphite Section
Battelle Blvd.
Richland, Washington 99352

Dr. William C. Morgan
Battelle Pacific Northwest Laboratory
Battelle Blvd
Richland, Washington 99352

TIC, Oak Ridge, TN. (27)

NOTICE

"This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research & Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately-owned rights."

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy \$ ____*; Microfiche \$2.25

<u>* Pages</u>	<u>NTIS Selling Price</u>
1-50	\$4.00
51-150	\$5.45
151-325	\$7.60
326-500	\$10.60
501-1000	\$13.60

Technical Information Department

LAWRENCE LIVERMORE LABORATORY

University of California | Livermore, California | 94550