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Lawrence Livermore Laboratory

DT FUSION NEUTRON IRRADIATION OF LLL NBTI SUPERCONDUCTOR WIRES AT 4.2°K
AND UNIVERSITY OF OXFORD Cu₂Au TEM SPECIMENS AT ROOM TEMPERATURE - April 7, 1978

Susan C. MacLean

May 17, 1978

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**DT Fusion Neutron Irradiation of LLN NbTi Superconductor Wires
at 4.2°K and University of Oxford Cu₃Au TEM Specimens**

at Room Temperature

April 7, 1978

Susan C. MacLean

Dr. Ronald M. Scanlan of LLN scheduled the LLN Rotating Target Neutron Source (RTNS) for two weeks beginning December 5, 1977. His samples were two NbTi superconductor wires to be irradiated at 4.2°K. Dr. Scanlan generously agreed to have Cu₃Au TEM specimens from Dr. M. L. Jenkins of the University of Oxford placed in front of the cold finger containing his superconductor samples for the first two days of the irradiation.

Fourteen Cu₃Au TEM samples (dimpled 3 mm discs) were loaded into seven holes punched in 0.18 mm thick mylar in a circular pattern with one center square. The specimens were held in place with front and back pieces of mylar. The sample positions were numbered around the circle 1 to 6 and the center was 7. Two niobium dosimetry foils, 12 mm in diameter and 0.03 mm thick, were scribed into seven pieces corresponding to the sample positions. The front niobium foil was labeled with "F" and the back foil with "B".

Dr. Scanlan's NbTi samples and two niobium dosimetry wires were held parallel to each other on a copper sample holder. The niobium wires were approximately 12 mm long and 0.25 mm in diameter. Nb-RS-9 was approximately 1.25 mm from NbTi specimen 1 and Nb-RS-10 was approximately 1.25 mm from NbTi specimen 2. The two specimens were about 2.75 mm from each other.

A niobium foil, 25.4 mm square and about 0.13 mm thick, was scribed into 16 equal squares, labeled and centered on the front of the cold finger of the Helitran. The profile foil was positioned so that the horizontal lines on it were parallel with the sample orientation.

Each time the Helitran was moved to make sample measurements a new profile foil was put in place before the irradiation was resumed. This occurred on December 5, 7, 12 and 14, 1977. The Cu₃Au TEM sample package was centered on the front of the first profile foil. The package was removed before measurements were taken on December 7, 1977.

The irradiation was carried out by the E Division Accelerator Staff during the period December 5 to 16, 1977. Neutron production was monitored

continuously with a proton recoil counter and recorded each hour. The total beam-on time was 139 hours. The dose record is attached.

Following the irradiation, the niobium dosimetry foils were cut along the scribed lines and the pieces weighed. All the niobium foils and wires were given to Ruth Anderson in the LLL Nuclear Chemistry Division for gamma ray counting.

The average fluence of each dosimeter was calculated using the method described in UCRL-51397, 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 463 millibarns (UCRL-80097). The results were as follows:

December 5 to 6, 1977

<u>Dosimetry Foil</u>	<u>Fluence (neutrons/cm²)</u>
Nb-J-1F	2.46×10^{16}
Nb-J-1B	2.05×10^{16}
Nb-J-2F	2.33×10^{16}
Nb-J-2B	1.94×10^{16}
Nb-J-3F	2.47×10^{16}
Nb-J-3B	2.00×10^{16}
Nb-J-4F	2.73×10^{16}
Nb-J-4B	2.27×10^{16}
Nb-J-5F	2.81×10^{16}
Nb-J-5B	2.34×10^{16}
Nb-J-6F	2.64×10^{16}
Nb-J-6B	2.16×10^{16}
Nb-J-7F	3.16×10^{16}
Nb-J-7B	2.47×10^{16}

Profile foil:

1021A	1021B	1021C	1021D
7.78×10^{15}	1.19×10^{16}	1.21×10^{16}	8.33×10^{15}
1022A	1022B	1022C	1022D
1.05×10^{16}	1.89×10^{16}	2.01×10^{16}	1.25×10^{16}
1023A	1023B	1023C	1023D
9.80×10^{15}	1.80×10^{16}	2.05×10^{16}	1.28×10^{16}
1024A	1024B	1024C	1024D
6.75×10^{15}	1.05×10^{16}	1.18×10^{16}	8.43×10^{15}

December 7 to 9, 1977

Profile foil:

1025A	1025B	1025C	1025D
1.83×10^{16}	2.96×10^{16}	2.79×10^{16}	1.95×10^{16}
1026A	1026B	1026C	1026D
2.93×10^{16}	5.83×10^{16}	5.75×10^{16}	2.72×10^{16}
1027A	1027B	1027C	1027D
2.76×10^{16}	5.83×10^{16}	6.31×10^{16}	2.92×10^{16}
1028A	1028B	1028C	1028D
1.73×10^{16}	2.99×10^{16}	3.17×10^{16}	1.85×10^{16}

December 12 to 13, 1977

Profile foil:

1029A	1029B	1029C	1029D
9.72×10^{15}	1.66×10^{16}	1.72×10^{16}	1.14×10^{16}
1030A	1030B	1030C	1030D
1.36×10^{16}	2.78×10^{16}	3.10×10^{16}	1.68×10^{16}
1031A	1031B	1031C	1031D
1.26×10^{16}	2.53×10^{16}	2.97×10^{16}	1.68×10^{16}
1032A	1032B	1032C	1032D
8.43×10^{15}	1.36×10^{16}	1.52×10^{16}	1.02×10^{16}

December 14 to 16, 1977

Profile foil:

1033A	1033B	1033C	1033D
1.80×10^{16}	3.09×10^{16}	3.25×10^{16}	2.18×10^{16}
1034A	1034B	1034C	1034D
2.39×10^{16}	4.77×10^{16}	5.37×10^{16}	3.19×10^{16}
1035A	1035B	1035C	1035D
2.07×10^{16}	3.88×10^{16}	4.54×10^{16}	2.81×10^{16}
1036A	1036B	1036C	1036D
1.37×10^{16}	2.11×10^{16}	2.32×10^{16}	1.66×10^{16}

December 5 to 16, 1977

Dosimetry Wires

Nb-RS-9

Nb-RS-10

Fluence (neutrons/cm²)

6.03×10^{16}

6.17×10^{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 dosimeter.

RTNS IRRADIATION OF NOVEMBER 7 TO 30, 1977

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