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Lawrence Livermore Laboratory

FISCAL YEAR 1977 DT FUSION NEUTRON IRRADIATIONS AND DOSIMETRY AT THE LLL
ROTATING TARGET NEUTRON SOURCE - October 26, 1977

Susan C. MacLean

May 17, 1978

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ABSTRACT

The DT fusion neutron irradiation of 352 samples during 16 irradiation periods (beam-on time of more than 1219 hours) is described. Experiments from 16 individuals representing eight institutions are summarized. Maximum flux in any of the room temperature runs was 9×10^{10} neutrons/cm²-sec for an 80 hour irradiation. The number of the UCID dosimetry reports detailing each of the irradiations are given.

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FISCAL YEAR 1977 DT FUSION NEUTRON
IRRADIATIONS AND DOSIMETRY AT THE LLL ROTATING TARGET NEUTRON SOURCE

In order to most efficiently utilize the LLL Rotating Target Neutron Source (RTNS) during the Fiscal Year 1977, 352 samples from 16 experimenters were combined during 16 irradiation periods. Beam-on time was more than 1,219 hours during FY 77.

The tables following list the dates, experimenters and their laboratory, and the samples for each irradiation. The temperature of the irradiation and the maximum fluence are also given. Nine of the irradiations were at room temperature. Two of the irradiations were at cryogenic temperatures and five were at elevated temperatures.

The $\text{Nb}^{93}(n, 2n)\text{Nb}^{92m}$ reaction was used to determine the 14.8 MeV neutron fluences (UCRL-51393, Rev. 1). The cross section used for the activation of the 10.16 day isomer of niobium by 14.8 MeV neutrons was 458 millibarns (UCID-16725). The UCID number for each irradiation is given if more details of the irradiation history and individual sample dosimetry are required.

Positioning and aligning the samples with the neutron beam prior to the irradiations was handled by Ralph H. Condit, Curtis L. Rowe and Michael W. Guinan. The neutron irradiations were carried out by members of the LLL E Division Accelerator Staff, Lewis P. Mego, Richard M. Penpraze, and Sharon A. Snowden. The gamma ray counting of the niobium dosimetry foils was performed by Ruth N. Anderson or Austin L. Prindle.

DT Fusion Neutron Irradiations - Fiscal Year 1977

Irradiation Dates	October 11-15, 1976		
UCID #	17468		
Beam-on time (hours)	65.88		
Experimenters	R. R. Vandervoort	G. F. Hurley H. Weinstock	R. H. Condit
Laboratory	LLL	LASL Illinois Institute of Technology	LLL
Samples	Six stainless steel tensile specimens with gauge sections approximately 1.6x6x0.5 mm. Three stainless steel tabs: 4x8x0.5 mm 10x10x0.5 mm 10x10x0.8 mm	Four high purity single crystal samples, approximately 4x4x4 mm. One each of YAG ($Y_3Al_5O_{12}$) Spinel ($MgAl_2O_4$) Sapphire (Al_2O_3) MgO	Ten silica-Supersil I samples approximately 10x2x2 mm. Seven CaF_2 crystals.
Temperature of experiment	Room temperature	Room temperature	Room temperature
Average fluence on front of sample (n/cm^2)	1.39×10^{17}	2.22×10^{16}	1.21×10^{16}
Measured property or technique used for analysis	Tensile properties	Optical properties	Helium production

DT Fusion Neutron Irradiation - Fiscal Year 1977

Irradiation Dates	November 17 - December 2, 1976				
UCID #	17472				
Beam-on time (hours)	148.71				
Experimenters	J. B. Mitchell	R. H. Jones D. L. Styris	C. L. Shead D. M. Parkin	G. F. Hurley B. Weinstock	R. H. Condit
Laboratory	LIL	BNL	BNL LSAL	LASL IIT	LIL
Samples	Eight Nb-1Zr tensile specimens that had been annealed one hr. at 1550°C. Measured approximately 28.6x9.5x0.45 mm with gauge sections 6 mm long, 1.6 mm wide.	Two wire-foil packets containing Nb, Ni, and stainless steel.	Eleven superconductor wires: two 19-core Nb ₃ Sn multifilament; three Nb ₃ Sn single core; three V ₆ Co single core; two NbTi Supercon 402; one NbTi cupronickel jacketed. (19 to 28 mm long)	Four high purity single crystal samples, approximately 4x4x4 mm. One each of YAG (Y ₃ Al ₅ O ₁₂), Spinel (Mg Al ₂ O ₄), Sapphire (Al ₂ O ₃), MgO	Seven Suprasil samples, approximately 2.5x2.5x3 mm. 35 microscope cover glasses, 25 mm diameter.
Temperature of experiment	Room Temperature	Room Temperature	Room Temperature	Room Temperature	Room Temperature
Average Fluence on front of sample (n/cm ²)	4.68×10^{17}	8.43×10^{16}	7.69×10^{16}	4.19×10^{16}	3.80×10^{16}
Measure property or technique used for analysis	Tensile properties and TEM	Tensile Properties	Critical current and critical temperature	Optical properties	Helium production

DT Fusion Neutron Irradiations - Fiscal Year 1977

Irradiation Dates	December 6-17, 1976	January 3-7, 1977		
UCID #	17470	17471		
Beam-on time (hours)	146.43	-		
Experimenters	R. M. Scanlan	C. L. Shead D. M. Parkin	R. H. Jones D. L. Styris	Y. Chen
Laboratory	LLL	BNL LASL	BNL	ORNL
Samples	Two NbTi superconductor wires	Eleven super conductor 19-wires; two 19-core Nb ₃ Sn multifilament; three Nb ₃ Sn single core; three V ₃ Ga single core; two NbTi Supercon-402; one NbTi cupronickel jacketed. (19 to 28 mm long)	One wire-foil packet containing Nb, Ni and stainless steel.	Two MgO crystals.
Temperature of experiment	4.2°K	Room temperature	Room temperature	Room temperature
Average fluence on front of sample (n/cm ²)	5.42×10^{16}	2.03×10^{16}	1.68×10^{16}	1.35×10^{16}
Measured property or technique used for analysis	Critical current	Critical current and critical temperature	Tensile properties	Optical absorption and EPR

DT Fusion Neutron Irradiation - Fiscal Year 1977

Irradiation Dates	January 17-21, 1977					
UCID #	17467					
Beam-on time (hours)	77.11					
Experimenters	J. B. Mitchell	C. L. Sneed D. M. Ruckin	R. H. Jones D. L. Skyris	Y. Chen	G. F. Hurley H. Weinstock	R. H. Condit
Laboratory	LLL	BNL LASL	BNL	ORNL IIT	LASL IIT	LLL
Samples	Eight Nb-1 Zr tensile specimens that had been annealed one hour at 1550°C. Measured approximately 28.6x9.5x0.45 mm with gauge sections 6 mm long, 1.6 mm wide.	Eleven superconductor wires: two 19-core Nb ₃ Sn multifilament; three V-Cu single core; two NBTI Supercon 402; one NBTI copper-nickel jacketed. (19 to 28 mm long)	One wire-foil packet containing Nb, Ni, and stainless steel.	Two MgO crystals	Four high purity single crystal samples, approximately 4x4x4 mm. One each of VAS (Y ₂ Al ₂ O ₇), Spinel (MgAl ₂ O ₄), Sapphire (Al ₂ O ₃), MgO	A small stack of glass microscope cover slides. Two halves of a broken bicrystal of LiF measuring approximately 25x25x15 mm.
Temperature of experiment	Room temperature	Room temperature	Room temperature	Room temperature	Room temperature	Room temperature
Average fluence on front of sample (n/cm ²)	2.51×10^{17}	5.18×10^{16}	4.69×10^{16}	4.18×10^{16}	3.56×10^{16}	1.86×10^{16}
Measured property or technique used for analysis	Tensile properties and TEM	Critical current and critical temperature	Tensile properties	Optical absorption and EPR	Optical properties	Helium production

DT Fusion Neutron Irradiations - Fiscal 1977

Irradiation Dates	January 24-28, 1977		March 14-15, 1977		
UCID #	17469		17528		
Beam-on time (hours)	76.73		-		
Experimenters	H. Farrar D. Knaff	R. H. Condit	C. L. Shead D. M. Parkin	R. B. Jones D. L. Styris	J. Chen
Laboratory	Atomics International	LLZ	BNL LASL	BNL	ORNL
Samples	Foils of Co, Zr, Au, Fe, Nb and Ni. Chunks of natural Ni, ^{58}Ni , ^{60}Ni , ^{64}Ni , ^{67}Ni , and ^{68}Ni .	Two pieces of pyrographite, 10x7x2 mm. Eight silica samples approximately 3x3x9 mm. 5.91×10^{16}	Eleven superconductor wires: two 19-core Nb_3Sn single core; three V_6Ga single core; two NbTi Supercon 402 one NbTi cupronickel jacketed.	One wire-foil packet containing Nb, Ni and stainless steel.	Two MgO crystals
Temperature of experiment	Room temperature	Room temperature	Room temperature	Room temperature	Room temperature
Average fluence on front of sample (n/cm ²)	2.38×10^{17}	5.91×10^{16}	2.77×10^{15}	2.06×10^{15}	1.65×10^{15}
Measured property or technique used for analysis	Helium production	Helium production	Critical current and critical temperature	Tensile properties	Optical absorption and EPR

DT Fusion Neutron Irradiation - Fiscal 1977

Irradiation Dates	March 22 - April 8, 1977	April 11, 1977	April 12-15, 1977	April 25 - May 2, 1977
UCID #	17665	17664	17665	17667
Beam-on time (hours)	190.17	2.17	57.17	70.13
Experimenters	R. R. Vandervoort	W. L. Barmore	R. R. Vandervoort	R. H. Jones
Laboratory	LLL	LLL	LLL	BNL
Samples	Five stainless steel tensile specimens, approximately 28.6x9.5x0.5 mm with gauge sections 6 mm long and 1.6 mm wide.	One niobium tensile specimen, approximately 28.6x9.5x1.6 mm with a gauge section 6 mm long and 1.6 mm wide.	Continuation of March 22 - April 8, 1977, irradiation. Five stainless steel tensile specimens.	14 stainless steel wires, nine Ni wires, one Nb foil and two Ni foils.
Temperature of experiment	450°C	700-800°C	450°C	175°C
Average fluence on front of sample (n/cm ²)	See April 12-15, 1977	3.35×10^{15}	2.58×10^{17}	6.05×10^{16}
Measured property or technique used for analysis	Tensile properties and TEM	Tensile properties	Tensile properties and TEM	Tensile properties

DT Fusion Neutron Irradiations - Fiscal 1977

Irradiation Dates	May 3-26, 1977	June 14-16, 1977	August 1-12, 1977	August 15-19, 1977	
UCID #	17666	17669			
Beam-on time (hours)	227.98	-	141.75	-	
Experimenters	J. B. Mitchell	R. H. Howell	R. M. Scanlan	C. L. Sneed D. M. Parkin	Y. Chen
Laboratory	LLL	LLL	LLL	SNL LASL	ORNL
Samples	Five Nb-1 Zr tensile specimens annealed one hour at 1550°C. Measured approximately 28.6x9.4x0.45 mm with gauge sections 6 mm long and 1.5 mm wide.	Copper foils	Two superconductor wires	Eleven superconductor wires: two 19-core Nb ₃ Sn multifilament, three Nb ₃ Sn single core; three V-Ga single core; two NbTi Supercon 402; one NbTi superconduct jacketed. (19 to 28 mm long)	Two MgO crystals
Temperature of experiment	600°C	Room temperature	4.2°K	Room temperature	Room temperature
Average fluence on front of sample (n/cm ²)	2.65×10^{17}	2.18×10^{16}	8.03×10^{16}	5.94×10^{16}	5.10×10^{16}
Measure property or technique used for analysis	Tensile properties and TM		Critical current	Critical current and critical temperature	Optical absorption and EPR

DT Fusion Neutron Irradiation - Fiscal 1977

Irradiation Dates	August 30, 1977		
UCID #			
Beam-on time (hours)	14.9		
Experimenters	C. L. Sneed D. M. Parkin	B. D. Evans J. M. Auch	G. F. Hurley H. Weinstock
Laboratory	BNL LASL	Naval Research Laboratory LASL	LASL IIT
Samples	Eleven superconductor wires: two 19-core Nb ₃ Sn multifilament; three Nb ₃ Sn single core; three V ₃ single core; two NbTi Supercon 402; one NbTi cupronickel jacketed. (19 to 28 mm long)	Six GeO ₂ crystals. Six crystals measuring approximately 20x10x5 mm each. Two each of Al ₂ O ₃ , Spinel (MgAl ₂ O ₄), and YAG. (Y ₃ Al ₅ O ₁₂)	Four high purity single crystal samples, approximately 4x4x4 mm. One each of YAG (Y ₃ Al ₅ O ₁₂), Spinel (MgAl ₂ O ₄), Sapphire (Al ₂ O ₃), MgO
Temperature of experiment	Room temperature	Room temperature	Room temperature
Average fluence on front of sample (n/cm ²)	1.89×10^{16}	1.58×10^{16}	5.95×10^{15}
Measured property of technique used for analysis	Critical current and critical temperature.	Optical properties	Optical properties.