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LPTR IRRADIATION OF UNIVERSITY OF PENNSYLVANIA

METGLAS SAMPLES

Susan C. MacLean and Curtis L. Rowe

January 15, 1976

Unclassified

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Dr. T. Egami of the University of Pennsylvania requested irradiation of two types of alloys, designated MetGlas #2826 and #2826B, in the Livermore Pool Type Reactor (LPTR).

The LPTR is a 3 MW heterogeneous tank-type pool research reactor. It is light water moderated and cooled, beryllium reflected. It has MTR-type fuel elements, composed of aluminum and enriched uranium.

The MetGlas samples and an iron dosimetry foil were packaged (Fig. 1) and irradiated in position E-1 of the reactor core. This position is located at the northwest edge of the core, in the beryllium reflector. The neutron spectrum is, therefore, moderated to a greater degree than in the center of the core. The spectrum has been evaluated by Richard V. Griffith of LLL, using multiple foil activation and iterative computer fitting (UCRL-50007-74-2). The spectrum in the absence of cadmium can be summarized as follows:

Neutron Energy	Flux (n/cm ² -sec)
<0.54 eV	3.39×10^{13}
0.54 eV to 0.1 MeV	1.04×10^{13}
0.1 MeV to 1.0 MeV	8.05×10^{12}
>1.0 MeV	3.95×10^{12}

Five flat wire samples each of MetGlas #2826 and #2826B were prepared for irradiation. MetGlas #2826 samples measured 42 mm in length and 1.4 mm

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in width. The MetGlas #2826B samples were also 42 mm long but were 0.8 mm wide. The composition of the two alloys was as follows:

	<u>MetGlas #2826</u>	<u>MetGlas 2826B</u>
	(at. %)	(at. %)
Nickel	40	49
Iron	40	29
Phosphorus	14	14
Boron	6	6
Silicon	--	2

The reactor water temperature is 40°C and the sample temperature was estimated to be less than 100°C. The irradiation was carried out by the LLL Radiochemistry Division LPTR operating staff for 5000 minutes during the period July 15, 1975 to August 1, 1975. The reactor power was monitored continuously by ionization chambers and particularly by the heat balance across the core. The power was controlled at 3 MW $\pm$ 5%. The irradiation schedule was as follows:

<u>Date (1975)</u>	<u>Length of Irradiation</u>
July 15	7 hours 6 minutes
July 16	6 hours 17 minutes
July 17	7 hours 28 minutes
July 18	7 hours 49 minutes
July 22	5 hours 47 minutes
July 23	7 hours 26 minutes
July 24	7 hours 47 minutes
July 25	7 hours 54 minutes
July 29	6 hours 46 minutes
July 30	6 hours 39 minutes
July 31	6 hours 57 minutes
August 1	5 hours 25 minutes

Following the irradiation, and due to the activity of the specimens, the sample can was stored for one month before opening. The MetGlas samples were returned to Dr. Egami at the University of Pennsylvania. The iron dosimetry foil was delivered to Ruth N. Anderson in the LLL Radio-chemistry Division. She carried out the gamma ray counting. A 1.57 mm thick cadmium absorber was required over the sample during the counting.

The ^{54}Fe (n,p) ^{54}Mn reaction in iron was used for the dosimetry measurements. The average fluence on the iron dosimetry foil was calculated using the method described in UCRL-51393, Rev. 1. The values used in the calculations were as follows:

Iron sample density - 7.9 gm/cm^3

^{54}Mn half-life - 312.3 days

Iron atomic mass - 55.847 amu

^{54}Fe isotopic abundance - 5.82%

Yield of 835 KeV gamma ray - 100%

t_0 was taken as the end of the irradiation period. Corrections were made for decay assuming a constant flux during the total time the sample can was in the reactor, including periods of no power. This introduces a negligible error because of the long half-life of ^{54}Mn .

The following spectrum - averaged cross sections were used:

$E > 0.1 \text{ MeV}$ 0.0283 barn

$E > 1.0 \text{ MeV}$ 0.0848 barn

These are based upon the spectrum measurements of Griffith and upon ^{54}Fe cross section data from the Livermore Evaluated Nuclear Cross Section Library (UCRL-50400, Vol.4, 1971).

The results were as follows:

<u>Dosimetry Foil</u>	<u>Fluence (n/cm²)</u>	
	<u>>1 MeV</u>	<u>>0.1 MeV</u>
Fe-D-111	1.30×10^{18}	3.90×10^{18}

The estimated overall uncertainty of these results is $\pm 30\%$. The values given here represent average fluences over the volume of the dosimetry foil. The fluences on the MetGlas samples are expected to correspond closely to these values because of the proximity of the samples and foil and the volume nature of the neutron source.

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