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FAST NEUTRON CROSS SECTION MEASUREMENTS

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Using the neutron generator of this Institute (14 MeV neutron) the following cross section measurements were carried out during the last year.

1) Inelastic Scattering on Cr-52

S.Tagesen, P.Hille

Production cross section for 1.4 MeV gamma-line of Cr-52 at (14.1±0.1) MeV neutron energy

740 mb ± 25%

Lit.: MIR 574, Sitzungsber.Österr.Akad.Wiss., S.Tagesen, P.Hille, in print.

2.) (n,2n) Cross Sections of Various Nuclei

R.Rieder, H.Münzer

nucleus	neutron energy	σ	remarks
Sr-86	14.7 ± 0.1 MeV	926 mb ± 5%	to ground state + 86% isomeric state of Sr-85
Sr-86	14.05 ± 0.05	863 mb ± 5%	- " -
Sr-86	14.70 ± 0.1	240 mb ± 5%	to 70min isomer only
Sr-86	14.70 ± 0.1	960 mb ± 5%	total
Zr-90	14.70 ± 0.1	138 mb ± 15%	to 4.4min isomer
Zr-90	14.70 ± 0.1	718 mb ± 5%	to ground state +93% isomeric state
Zr-90	14.05 ± 0.05	595 mb ± 5%	- " -
Zr-90	14.70 ± 0.1	728 mb ± 5%	total
Nb-93	14.70 ± 0.1	452 mb ± 5%	
Nb-93	14.05 ± 0.05	470 mb ± 5%	
Y-89	14.70 ± 0.1	989 mb ± 7%	
Y-89	14.05 ± 0.05	915 mb ± 5%	
Rb-85	14.70 ± 0.1	1391 mb ± 5%	
Rb-85	14.05 ± 0.05	1011 mb ± 5%	
Rb-87	14.70 ± 0.1	1518 mb ± 10%	
Rb-87	14.05 ± 0.05	1394 mb ± 10%	
Ru-96	14.70 ± 0.1	838 mb ± 5%	

In addition the sum cross section for the reactions

$$Ru\text{-}96(n,np) + (n,pn) + (n,d) = 364 \text{ mb} \pm 20\%$$

was obtained for 14 MeV neutrons.

R.Rieder, Thesis, Univ.of Vienna, 1964.

BURN-UP DETERMINATION OF NUCLEAR FUELS BY HIGH RESOLUTION GAMMA-SPECTROSCOPY.

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A Compton spectrometer using a Li-drifted Si-detector as scattering crystal has been constructed. The full half width of the Compton peaks obtained is between 12-15 keV in the gamme energy range of interest for fission product analysis. The method was successfully applied to non-destructive determination of burn-up in irradiated fuel elements, measuring the intensity of the Cs-137 Compton peak after a cooling time as short as 2 weeks.

A quantitative check of the accuracy of the method using a MTR-fuel element, irradiated under precisely known conditions was carried out. The calculated burn-up of this fuel element agreed with the one deduced from the measured intensity of the Cs-137 line within 2%. The accuracy of the method is estimated to 10%.

A non-destructive determination of burn-up of the entire core of the ASTRA reactor comprising 24 MTR fuel elements was carried out by this method.

A comparison of the results with the data obtained from the reactor log-book will be published soon.

DETERMINATION OF THE THERMAL AND EPITHERMAL FISSION YIELDS OF Cs-136, Cs-137, Ru-103, Ru-106 in U-233 and U-235.

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As outlined in EANDC(OR)30 some radiochemical fission yield measurements were carried out. The main problem was to check differences in yields[1] for thermal and epithermal fission in a reactor spectrum. The fission yields for Cs-136, Cs-137, Ru-103 and Ru-106, Ba-140 were determined as well for U-235 as for U-233 samples. The results given in the following chart show no differences between thermal and epithermal yields for the fission products investigated.

Remarkable are, however, deviations of the measured thermal fission yields in comparison with earlier publications[2]. The errors of the yields quoted are estimated to + 6%. The full content of this work is in publication in Nukleonik.

Yields, U-235 in %

	Ru-103	Cs-136	Cs-137	Ba-140
thermal	2.97	0.0086	xx)	6.35
epith.	2.97	0.0086	6.13	6.35
therm.(Katcoff)	3.00	0.0068	6.15	6.35
diff.th. % x)	-1	+ 26	xx)	0

Yields, U-233 in %

	Ru-103	Ru-106	Cs-136	Cs-137	Ba-140
thermal	1.4	0.157	0.103	6.82	5.4
epith.	1.4	0.154	0.102	6.82	5.4
therm.(Katcoff)	1.8	0.24	0.12	6.58	5.4
diff.th x) %	-22	-35	-15	+4	0

x) The difference between our thermal yields and the values of Katcoff[2] given in %.

xx) These values were discarded due to defects in measuring equipment.

Literature

1) Roeland et al: Proc.II.Geneva Conf.,1958,15,Paper 551, p.440
B.P.Bayhurst et al: Phys.Rev.107,325(1957)
R.Nasuhoglu et al: Phys.Rev.108,1522(1957)
W.E.Grummit, G.H.Milton, J.Inorg.Nucl.Chem.20,6(1961)

2) S.Katcoff: Nucleonics 18,No.11, 201 (1960).

MASSANALYTICAL MEASUREMENTS OF NEUTRON CAPTURE CROSS SECTIONS OF NEIGHBOURING STABLE ISOTOPES

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For many neighbouring stable isotopes especially in the rare earth region (e.g. Gd,Dy,Yb,Er,Sm) neutron capture cross sections are not or only very inaccurately known. A program has been initiated to do such measurements,applying the following method·

a) Enrichment of the respective isotopes to be measured by our electromagnetic isotope separator.

b) Irradiation in the ASTRA reactor at a flux of 10^{-19} - 10^{-20} nvt, together with a flux monitor (with and without Cd-shielding).

c) Mass spectrometric isotope analysis of the unirradiated and irradiated sample and calculation of cross section.

Regarding the high cross section of Gd-157 the isotopes Gd-156 and Gd-155 were mass separated first, and are now under irradiation in the ASTRA reactor.

DETERMINATION OF THE PAIR PRODUCTION CROSS SECTION FOR 6.13 MeV Gamma Rays

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The measurements were carried out as described in EANDC(OR)30 for the elements Cu, Ni and Ag.

All cross sections measured are about 5% lower than those given by the Bethe-Heitler theory but the deviation is statistically significant only in the case of Ag.

The full content of the work will be disitributed as EANDC report.