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**LMFBR Reaction Rate
and Dosimetry
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MASTER

Hanford Engineering Development Laboratory

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J. DECAY SCHEME INFORMATION FOR ANALYSIS OF RADIOCHEMISTRY FOIL MEASUREMENTS

R. G. Helmer and R. C. Greenwood

Objective

- Provide an evaluated set of decay scheme information allowing the various laboratories to carry out consistent analyses of the radiochemistry foil packets.

Summary

For the radioactivities that are to be observed in the foils in these packets, the available decay scheme literature has been reviewed. Values are presented for the half-lives and the gamma-ray energies and absolute intensities for from one to three prominent transitions from each isotope. The uncertainties (1σ value) are given for each quantity.

Accomplishments and Status

Four radiochemistry foil packets have been irradiated and the gamma-ray spectra measured. The first step in the analysis of these data will be to determine the level of agreement between the various laboratories. The second step will involve the use of the activity levels in the analysis of the neutron spectrum. The decay scheme information needed for this comparison is given in Table ANC-14. Uncertainties (1σ level) are given for all of the values.

Expected Accomplishments

This evaluation is complete, unless it is found that more information is needed for future experiments.

TABLE ANC-14

A SET OF RECOMMENDED HALF-LIVES, GAMMA-RAY ENERGIES AND
BRANCHING RATIOS FOR THE RADIOCHEMISTRY FOIL MEASUREMENTS

Radioisotope	Half-Life ^a $t_{1/2}$	Gamma-Ray Energy ^a (keV)	Gamma-Ray Branching Ratio ^a (%)	
²⁷ Mg	9.46(2) m	843.73(4) 1014.44(5)	71.4(5) } 28.6(5) }	sum = 100.0
²⁴ Na	14.99(2) h	1368.52(6) 2753.98(10)	99.99(1) 99.85(2)	
⁴⁶ Sc	83.85(10) d	889.258(18) 1120.516(25)	99.98(1) 99.99(1)	
⁴⁷ Sc	3.39(4) d	159.39(5)	69.0(25)	
⁴⁸ Sc	43.8(1) h	983.4(2) 1037.4(3) 1311.9(3)	99.98(1) 97.7(3) ^b 99.99(1)	
⁵⁴ Mn	312.6(3) d	834.827(21)	99.978(2)	
⁵⁹ Fe	44.6(1) d	1099.224(25) 1291.564(28)	55.5(17) } 44.1(12) }	sum = 99.6(1)
⁵⁸ Co	71.3(2) d	810.757(21)	99.44(2)	
⁶⁰ Co	5.268(5) y	1173.208(25) 1332.491(41)	99.86(2) 99.985(1)	
⁶⁴ Cu	12.78(5) h	511.002 ^c	36.8(16)	
^{115m} In	4.50(2) h	336.2(1)	47.0(20)	
^{116m} In	54.10(20) m	1293.4(3) 2112.1(4)	83.7(15) } 16.2(15) }	sum = 99.93(2)
¹⁴⁰ Ba	12.79(1) d ^d			
¹⁴⁰ La	40.26(2) h ^d	1596.18(5)	95.33(16)	
¹⁹⁸ Au	2.696(2) d	411.794(8)	95.47(10)	
²³⁹ Np	2.355(4) d	228.19(1) ^e 277.60(3) ^f	12.5(15) ^e 14.5(15) ^f	

^a The numbers in parentheses indicate the uncertainty (1 σ) in the last digit(s).

^b The combined intensity of the 1037-keV gamma ray and a 1212-keV gamma ray is (99.98 $\pm$ 0.01)%.

^c The effective line-energy of this peak may be lower than this energy due to electron binding effects and the finite width of the annihilation radiation energy distribution.

^d The ratio $t_{1/2}(\text{Ba})/[t_{1/2}(\text{Ba}) - t_{1/2}(\text{La})]$, which is the ratio of the ¹⁴⁰La to ¹⁴⁰Ba activities in a mixed ¹⁴⁰Ba-¹⁴⁰La source at equilibrium, is therefore 1.15096 $\pm$ 0.00012.

^e There is also a gamma-ray transition of 226.4 keV which has an intensity of 0.7%.

^f There are also gamma-ray transitions of 272.8 keV and 280.5 keV, but both have intensities of less than 0.1%.