NEW GAMMA RAYS FROM DECAY OF ^{189}W

Yang Weifan (杨维凡), Zhao Zhizheng (赵之正), Li Zongwei (李宗伟),
and Mu Wantong (牟万统)
(*Institute of Modern Physics, The Chinese Academy of Sciences, Lanzhou 730000*)

ABSTRACT

Radioactivities of ^{189}W are produced through an ^{192}Os(n, α)^{189}W reaction. Gamma ray spectroscopy from chemically separated tungsten sources using HPGe detector has revealed the presence of 22 gamma rays assigned to the decay of ^{189}W. Of them, 18 gamma rays are new ones unreported until now.

Keywords Gamma-rays spectra, Chemical separation, Decay curve resolution

1 INTRODUCTION

Flegenheimer *et al*[1] reported ^{189}W with a half-life of 11 min in chemically separated tungsten fraction has been found by an Os(n, α) reaction. Kauranen and Ihochi[2] also investigated by β and γ spectroscopy the decay of ^{189}W ($T_{1/2}$=11.5 min) produced through the Os(n, α) reaction. So far, there is no the other publication on its decay properties. The present study reports the results of gamma ray spectroscopy from chemically separated tungsten sources through bombarding natural osmium targets with fast neutrons.

2 PROCEDURES

In polythene boxes, 2~5 g of osmium metal sponge was bombarded for 20~30 min with 14 MeV neutrons at the Cockroft-Walton accelarator of the Lanzhou University. The neutrons flux was about 10^{11} neutrons/(cm^2·s). Radioactivities of ^{189}W were produced by the ^{192}Os(n, α) reaction. After the end of irradiation, the target sample was dissolved in hot concentrated nitric acid. OsO_4 was distilled over and collected in 6 mol/L NaOH solutions, tungsten was then isolated from rhenium. The tungsten sources were used for activity measurement. The measurement could be started 15~20 min after the end of bombardment.

A HPGe detector having a resolution of 1.5 keV at 1331 keV was used in a low background lead chamber to obtain γ-ray single spectra of the tungsten sources. The measurement was made in a multispectrum mode. The data were recorded on magnetic disks with a PC-CAMAC multiparameter data acquisition system. The cumulative γ-ray spectra were analysed using a set of computer programs. The least-square technique was used for the decay curve resolution to obtain half-lives of individual peaks.

3 EXPERIMENTAL RESULTS AND DISCUSSION

It was found that except γ lines of ^{187}W, there are 22 γ-lines in Fig.1 with half-lives of 11.5 min or so. They are in fair agreement with the value of ^{189}W (11.5 min) originally reported by Kauranen *et al*[2]. Of them, 18 γ lines are new γ rays unreported

Manuscript received date: 1995–05–08

until now. Their energies are 126.2, 143.8, 210.6, 220.0, 229.7, 403.9, 668.6, 750.6, 786.3, 847.1, 864.1, 871.7, 957.6, 974.3, 1001.4, 1185.3, 1418.8 and 1466.2 keV, respectively. The results of the spectroscopic analysis are listed in Table 1.

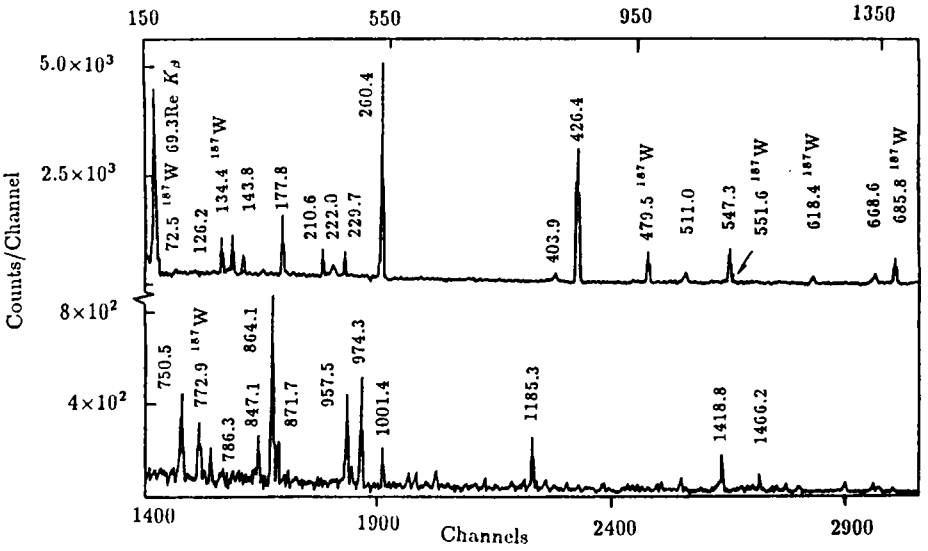

Fig.1 Gamma-ray spectrum of the tungsten fraction separated from natural osmium bombarded by 14 MeV neutrons

Table 1

Energies and intensities of γ-rays emitted by ^{189}W

Present work			Kauranen *et al*[2]		Present work		
Half-life/ s	Energy/ keV	Relative intensity	Energy/ keV	Relative intensity	Half-life/ s	Energy/ keV	Relative intensity
11.7±1.0	126.2±0.1	9.5±0.4	94±5	3	12.1±1.0	750.6±0.3	6.7±0.4
11.7±1.7	143.8±0.1	5.1±0.3	130±2	12	11.5±0.9	786.3±0.2	2.7±0.2
12.2±0.7	177.8±0.1	18.4±0.6	178±2	13	11.3±1.1	847.1±0.2	4.0±0.3
11.5±0.7	210.6±0.2	8.6±0.4	222±8	3	11.5±1.0	864.1±0.3	12.6±0.9
11.3±1.1	220.0±0.3	6.5±0.8	258±3	100	10.7±2.0	871.7±0.4	3.2±0.5
11.8±0.4	229.7±0.2	11.4±0.6	360±8	10	11.8±1.2	957.5±0.1	8.3±0.6
11.8±0.5	260.4±0.2	100±1.0	417±4	96	11.8±1.2	974.3±0.7	11.3±0.8
12.2±1.2	403.9±0.5	6.7±0.3	550±10	28	12.5±1.2	1001.4±0.5	4.1±0.3
11.3±0.2	421.4±0.5	100.8±2.0	855±15	20	11.3±1.2	1185.3±0.6	4.4±0.5
12.2±0.6	547.3±0.6	27.7±1.1	955±20	20	11.7±1.1	1418.8±0.5	4.5±0.4
12.0±1.0	668.6±0.5	10.9±0.8			11.0±1.3	1466.2±0.7	2.3±0.3

No other activities could be detected in chemically separated tungsten sources, except for ^{187}W and ^{189}W γ-lines. Furthermore, the half-lives of other radioactive tungsten isotopes (including their isomers) which could be produced in the bombardment are quite

different from half-lives of ^{189}W. Thus, the 18 new γ-rays seen now clearly must be attributable to the decay of ^{189}W. Some of the decay curves for the γ-rays are shown in Fig.2.

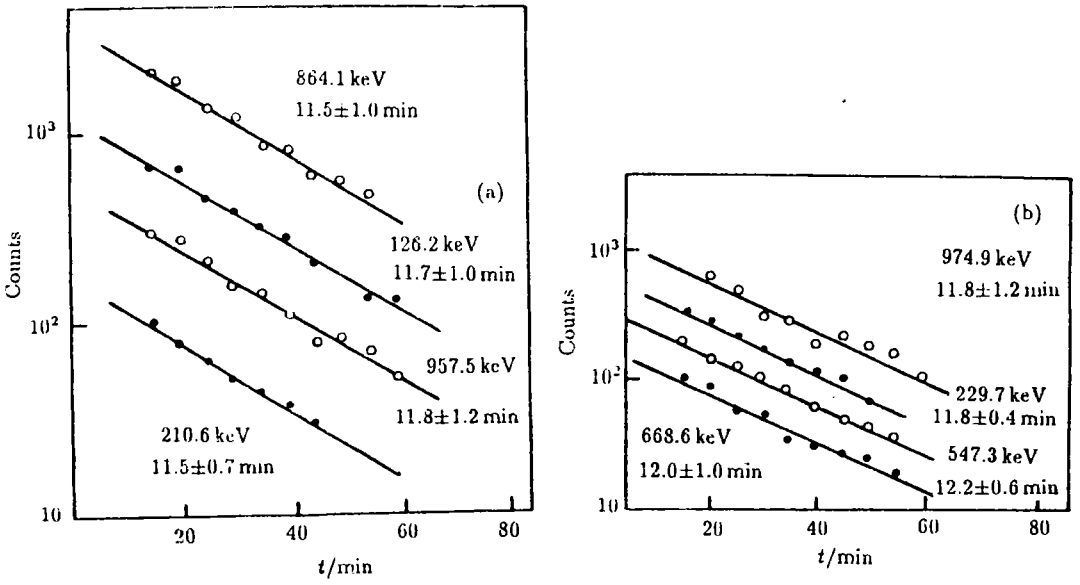

Fig.2 Decay curves for some of new γ-rays in the tungsten sources

Kauranen *et al*[2] reported that a total of 10 γ-rays emitted by ^{189}W has been observed. The energies and intensities for 4 γ-rays of them (178±2, 258±3, 417±4 and 550±10 keV) are in rough agreement with our values for 177.8, 260.4, 421.4 and 547.3 keV γ-rays. Intensities for two γ-rays at 855± 15 and 955±20 keV seems to be the sum of those γ-rays at 847.1, 864.1 and 871.7 keV as well as 957.5 and 974.3 keV in Fig.1, respectively. It may be the fact that the NaI detector used by Kauranen *et al*[2] was limitted in the energy resolution. It is also all the same to 222± 8 keV γ-rays, 222±8 keV γ-rays may be the sum of (210.6+222.0+229.7 keV) three γ-rays. The intensities Kauranen *et al*[2] gave is obviously lower than the sum of the three γ-rays measured in our experiment. The γ-rays at 99 and 366 keV which Kauranen *et al*[2] assigned them to the decay of ^{189}W were not observed in our work.

REFERENCES

1 Flegenheimer J, Baro G B, Viirsoo M. Radiochim Acta, 1963; 2:7
2 Kauranen P, Ihochi H. J Inorg Nucl Chem, 1965; 27:1451