

DETERMINATION OF ALPHA DECAY PROBABILITY OF ^{238}U , ^{234}U , ^{239}Pu , ^{241}Am ISOTOPES

Le Xuan Chung, Tran Viet Nhan Hao, Pham Quoc Hung, Vu Thanh Mai

Department of Physics, College of Science, VNU

1. Introduction

^{238}U , ^{234}U , ^{239}Pu , ^{241}Am are α -decay nuclei. They can emit α particles and become lighter nuclei. In this paper, probabilities of α -decay channels are determined. We are only interested in the channels due to high decay probability. A α -standard source was used and measurements were performed at Department of Nuclear Physics, Hanoi University of Sciences.

2. Experiments and results

a) Decay schemes of Isotopes ^{238}U , ^{234}U , ^{239}Pu , ^{241}Am

The below figures [1] present main decay channels of 4 isotopes ^{238}U , ^{234}U , ^{239}Pu and ^{241}Am with their probabilities. There are 3 channels of ^{238}U , ^{234}U , ^{239}Pu and 4 channels of ^{241}Am to be taken into account.

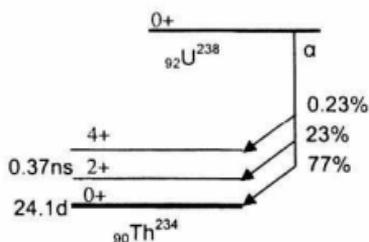


Fig.1. Decay scheme of $^{92}\text{U}^{238}$

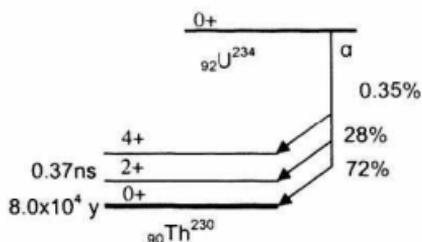


Fig. 2. Decay scheme of $^{92}\text{U}^{234}$

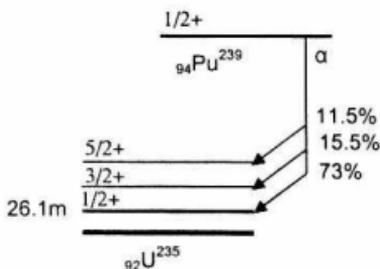


Fig.3. Decay scheme of $^{94}\text{Pu}^{239}$

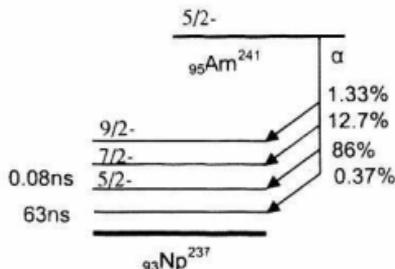


Fig.4. Decay scheme of $^{95}\text{Am}^{241}$

b) Alpha Spectra of above isotopes measured by Alpha Analyst Spectrometer

Used alpha source is IAEA standard. It was prepared by electron deposition of a mixture of α - emitters onto a stainless steel disk. Standard source's calibration date was in June 10, 2002 10:00, total activity was 374.4 dpm and its diameter of active area was 24.4 mm [4].

Figure 5 presents the alpha spectrum measured by Spectrometer Alpha Analyst.

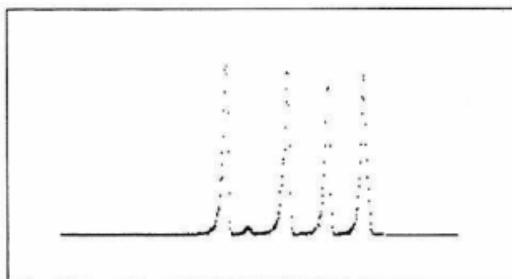


Fig. 5. Spectrum of IAEA standard source

The silicon surface barrier detector was used. The depletion depth of silicon surface barrier detector is normally too small to develop significant pulses from low dE/dx radiation from cosmic ray or gamma ray-interaction, so the residual background rate is negligible in virtually and conceivable application to the detection of charge particles [3].

c) Determination of alpha decay probability

Table 2. Alpha decay channel probabilities

Nuclide	Alpha energy (MeV)	Probability (%)		
		Exp.	[1]	[2]
^{238}U	4.16 ± 0.04	1.40 ± 0.03	0.23	0.10
	4.18 ± 0.04	20.90 ± 0.42	23.00	29.00
	4.22 ± 0.04	77.70 ± 1.54	77.00	70.90
^{234}U	4.70 ± 0.05	10.30 ± 0.21	0.35	0.20
	4.72 ± 0.05	19.50 ± 0.40	28.00	28.40
	4.76 ± 0.05	70.20 ± 1.40	72.00	71.40
^{239}Pu	5.02 ± 0.05	0.90 ± 0.02	11.50	11.50
	5.06 ± 0.05	13.60 ± 0.27	15.50	15.10
	5.11 ± 0.05	85.40 ± 1.70	73.00	73.30
^{241}Am	5.33 ± 0.05	1.26 ± 0.02	1.33	1.60
	5.38 ± 0.05	12.19 ± 0.20	12.70	13.00
	5.42 ± 0.05	82.16 ± 1.64	86.00	84.50
	5.46 ± 0.05	4.37 ± 0.09	3.70	0.56

Spectrum separation Software [2] was used. This software allows us to separate spectrum into suitable number of Gaussian peaks. The program gives informations of each Gaussian peak including energy, centroid, area, FWHM... Fig. 6, 7, 8, 9 present spectrum separation for ^{238}U , ^{234}U , ^{239}Pu and ^{241}Am . Alpha decay channel probabilities were calculated through the counts for corresponded peak.

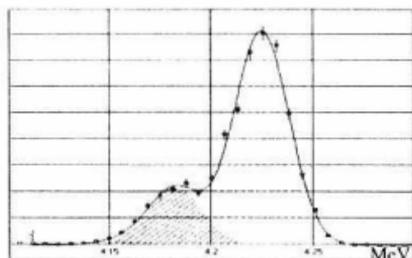


Fig.6. Spectrum separation for U-238

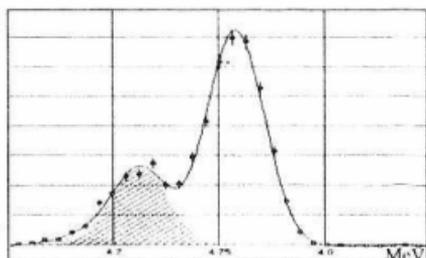


Fig.7. Spectrum separation for U-234

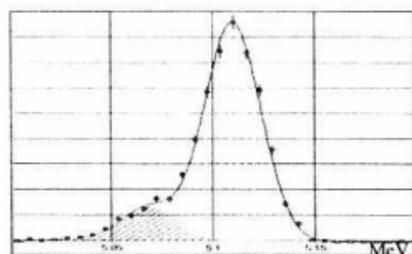


Fig.8. Spectrum separation for Pu-239

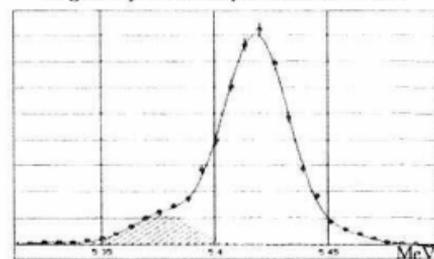


Fig.9. Spectrum separation for Am-241

3. Conclusion

For analysis of alpha particles of about several MeV energies emitted from radioactive isotopes the Alpha Analyst Spectrometer using surface barrier silicon detector is suitable. The received results in this study agree with the others.

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