CYCLOTRON PRODUCTION OF ^{139}Ce FROM LANTHANUM TARGETS

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Introduction.

^{139}Ce radionuclide ($T_{1/2}$ = 137.5 days) is usually obtained from the fission products of uranium or at the cyclotron. Isolation of ^{139}Ce from the fission products of uranium [1,2]) is accompanied by a large number of radioactive waste products. At the cyclotron ^{139}Ce is obtained by nuclear reactions:

$$^{139}\text{La (d, 2n) } ^{139}\text{Ce} \quad (1)$$

$$^{139}\text{La (p, n) } ^{139}\text{Ce} \quad (2)$$

By the energy of particles 22 MeV ^{139}Ce yield by reactions 1 and 2 consists 1.6 MBq/mA h and 0.39 MBq/mA h accordingly [3]. At [4,5] reports ^{139}Ce radionuclide is obtained by irradiation of lanthanum target at the cyclotron. Method of isolation of ^{139}Ce in these works is based on cerium's oxidation to Ce(IV).

At our work ^{139}Ce radionuclide was obtained by using reaction (d,2n) having the more yield.

Experimental procedure

The target for irradiation was consisted from the coating was bring at the cooper support the aluminum oxide and lanthanum. The given target is able to exposure the warm loading accordingly the flow of deitron`s (E=22MeV) till 40 μA. The irradiation of the target was conducted by deitron`s with energy of 22 MeV by the current of particles 40 μA the calculation yield of ^{139}Ce made 1.36 MCi/h.

After the week's exposure the target was processed by 19 N NaOH. The made sedimentary filtered, washed by water at the Shatt`s filter (No 4) and dissoluted in 3 ml of concentrated HNO_3. The solution evaporated and the dissoluted in 2 ml of 6 M $LiNO_3$ (pH = 2.0). Further the radiochemical purification with the using of chromatographic columns with trioctylamine (TOA) and di-2-et- hyhexyl ortophosphoric acid (D2EHPA). For TOA and D2EHPA fixing in the solid phase the (r–400 mesh) F–4 was used.

Results and discussion

Preliminary the behavour of La and Ce in the systems TOA – $LiNO_3$ (pH = 2.0) and D2EHPA – HNO_3 with the using of radionuclides ^{140}La and ^{141}Ce was studied. In table 1 the dynamic distribution's coefficient of La and Ce in the investigated systems is conducted. Both systems give an approximately the same results. The separation effect of La–Ce pare makes 3.

Dynamic distribution coefficients of La and Ce in D2EHPA – HNO in TOA – $LiNO_3$ systems.

Table 1.

Systems	Elements	Coefficients of distribution			
		HNO_3, mol/l			
		0,2	0,3	0,4	0,5
D2EHPA	La	6,0	1,9	0,7	0,3
	Ce	17,6	5,3	2,1	1,0
		$LiNO_3$, mol/l			
		3,0	4,0	5,0	6,0
TOA	La	19,0	63,5	166	343
	Ce	6,0	20,0	52,5	108

^{139}Ce purification of the received solution lantanium target presented 2 staged process on the 2 chromatographic columns. The first stage: separation of carrier-free ^{139}Ce from the macroquantitative Lantenium way was made on the columns with TOA.

The second stage: purification of ^{139}Ce was made on the columns with D2EHPA. Flow-rate of liquid phase in the columns made 0.6 ml.cm^{-2} min^{-1} and 0.5 ml cm^{-2} min^{-1} accordingly. ^{139}Ce was elutied from one column 3.5 mol/l $LiNO_3$ and from the second column 0.325 mol/l HNO_3.

Radiochemical purity of ^{139}Ce made 99.9. Gamma-spectrum of the obtained ^{139}Ce is shown on the fig. 1. These facts are satisfactory agree with work [6] (see fig. 2). From the target ^{139}Ce radionuclide –11.0 mCi is obtained. The yield made 80.8 .

The monoenergetic radiation of ^{139}Ce enables applications it as a source for calibration of γ-chambers, and also manufacturing various appliances, used in medicine.

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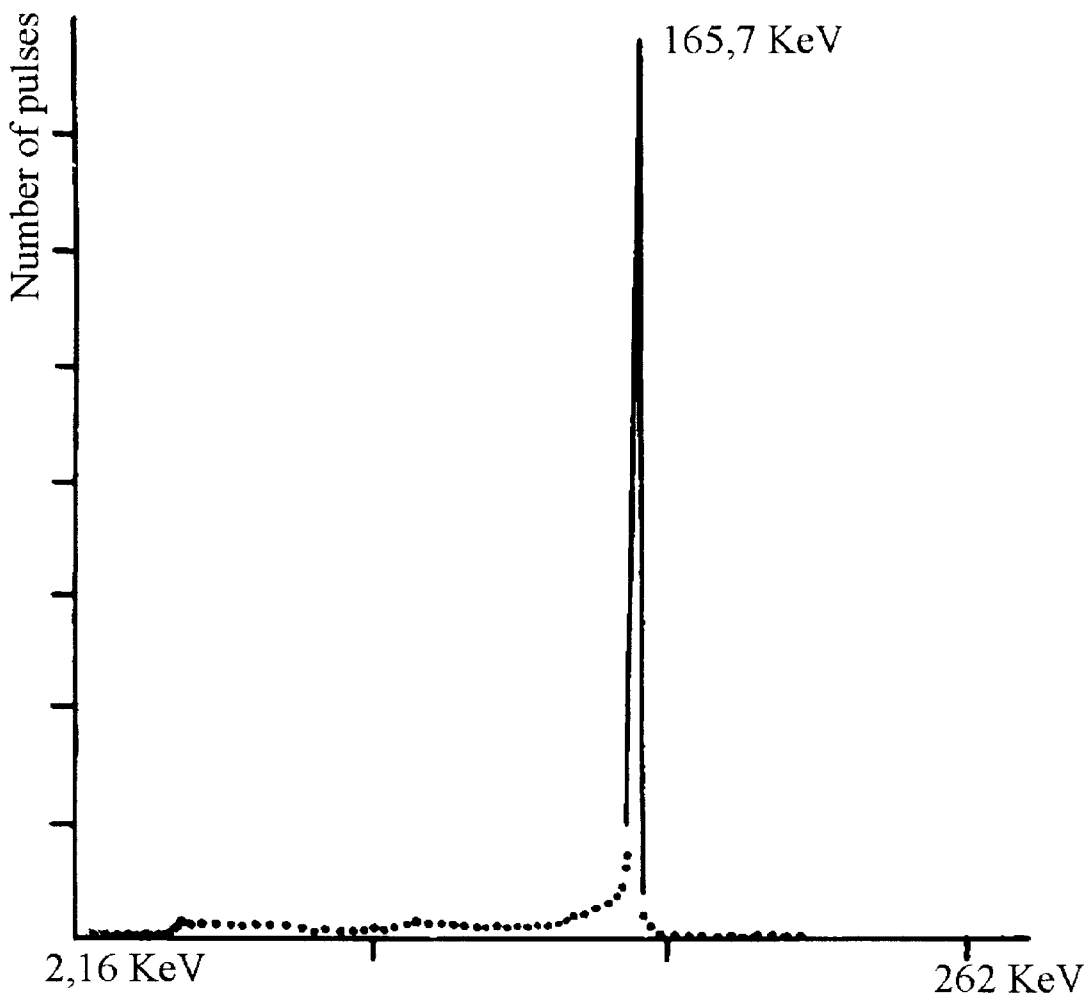

Fig. 1. Gamma-spectrum of the ^{139}Ce.