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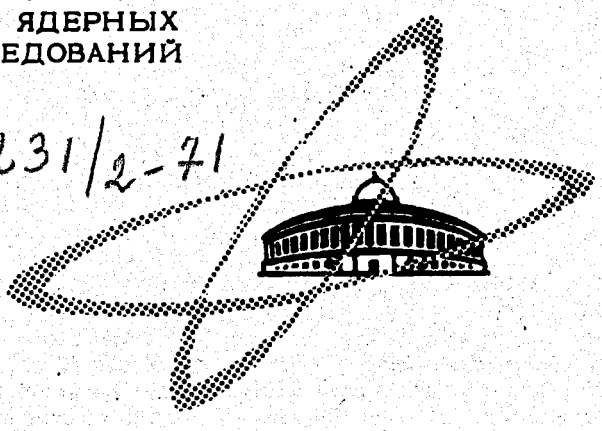

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ELECTROMIGRATION SEPARATION OF TRANSURANIUM ELEMENTS IN SOLUTIONS OF ETHILENDIAMINTETRACETIC AND CYCLOHEXANDIAMINTETRACETIC ACIDS

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ELECTROMIGRATION SEPARATION OF TRANSURANIUM ELEMENTS IN SOLUTIONS OF ETHILENDIAMINTETRACETIC AND CYCLOHEXANDIAMINTETRACETIC ACIDS

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Introduction

The relatively high difference between the stability constants of neighbouring elements for the complexes of trivalent transuranium elements (TUE) with EDTA and CDTA[1] suggests that the possibility exists to utilize these complexes for electromigration separation of TUE. In the present work conditions, under which similar separation of TUE is possible, were investigated and the electromigration behaviour of some α-active elements (Po, Ac, Pa, Th, Ra) accompanying TUE in nuclear reaction products was studied. Thin-layer electrophoresis was used for fast separation of microquantities of TUE and milligramme quantities of lanthanum.

Experimental

The experiments were carried out with the standard apparatus for electromigration with a porous filter.

The separation was performed on stripe of Whatman 31-ET chromatography paper (1 x 50 cm). The mixture of the elements in the electrolyte solution (0.03 ml) was spread on a strip of this paper pretreated with the working solution. Solutions of sodium

salts of the corresponding acids (cerium nitrate 10^{-6}M) were used as an electrolyte. To prevent the evaporation of electrolyte solution and to maintain the temperature required kerosene was used. pH of the solutions was adjusted by adding an approximate volume of nitric acid. The measurements of pH were carried out by using the "Bekman-R" pH -meter .

An electrophoresis was also carried out with thin-layer of cellulose powder "Whatman-for chromatography". The dimensions of a thin-layer were - 0.2 x 1.5 cm (3-4 g of cellulose). During the experiment the layer was covered with glass.

The isotopes ^{239}Pu , ^{241}Am, ^{244}Cm , ^{231}Pa , ^{227}Ac , ^{211}Po , ^{233}Th , ^{243}Bk , ^{246}Cf , ^{252}Fm were used.

The purity of the isotopes used was checked by their α -spectra and, if necessary, by their half-lives.

Results and Discussion

As a result of a series of experiments a complete separation of TUE was achieved when using $2.69 \cdot 10^{-4}$M EDTA solution at pH = 1.74, a temperature of 15° and a voltage of 1500 v ($\Delta v = 30$ v/cm), 1 to 2 hours were enough for one run of experiments (Figs. 1,2,3). The presence of lanthanum in the mixture to be separated did not affect the separation. This permits to employ lanthanum as a carrier in the extraction of TUE from reaction products. In the latter case TUE are accompanied by the rare earth elements which under these conditions should partially separate[2].

The separation of Am and Cm could be achieved in 30 minutes at the potential gradient 50 v/cm (2.500 v).

The utilization of CDTA solutions ($2.75 \cdot 10^{-4}$M) permits one to separate Am and Cm at $pH = 2.10$ for one hour (Fig. 4).

Electromigration behaviour of neptunium and uranium was investigated in EDTA solution. At $pH = 1.74$ and the 1500 v voltage ($\Delta v = 30$ v/cm) good separation of four-, five- and sixvalent state of neptunium is obtained. The behaviour of NpO_2^{2+} is similar to that of PuO_2^{2+}, Np^{4+} - to Am^{3+}. NpO_2^{+} migrates nearly as fast as actinium. We failed to obtain unambiguous and reproducible results for uranil ions due to the broadening of the zone at the given pH.

It should be noticed that under the experimental conditions Po, Ra and Th are staying on the start point, Ra moves forward, possessing a significantly greater mobility and Ac moves nearly together with lanthanum.

The fast separation of TUE and milligram quantities of lanthanum by means of a thin-layer electrophoresis may be possible due to the fact that up to $pH < 2.00$ lanthanum does not form significant complex formation with EDTA ($2.69 \cdot 10^{-4}$M). The procedure takes 35 minutes at 50°C temperature and 1200 v ($\Delta v = 24$ v/cm) voltage.

Acknowledgements

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References

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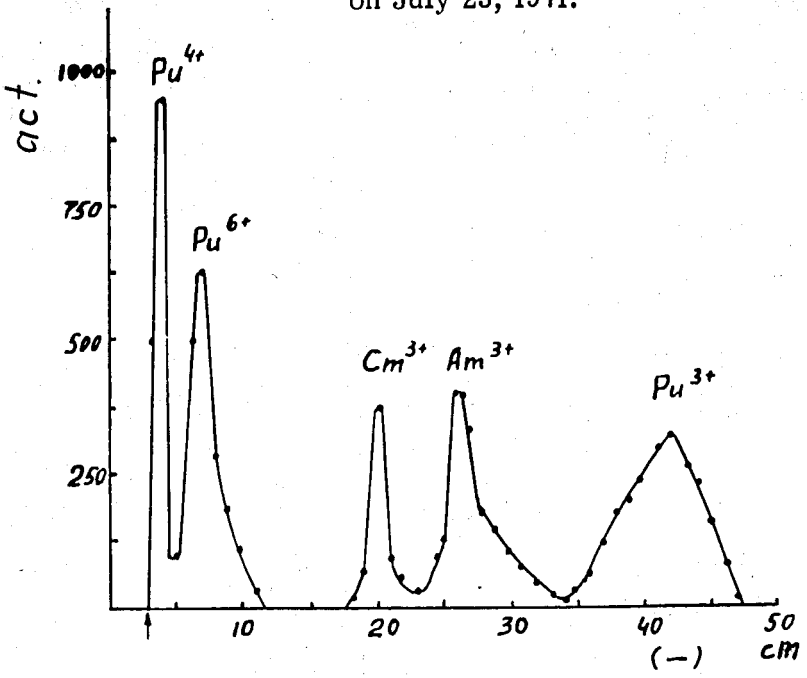

Fig. 1. Separation of Am, Cm, Pu (the arrow indicates the starting point). $\Delta V = 30$ v/cm, $pH = 1.74$, 15° C, [EDTA] $= 2.69 \cdot 10^{-4}$ M, 120 min.

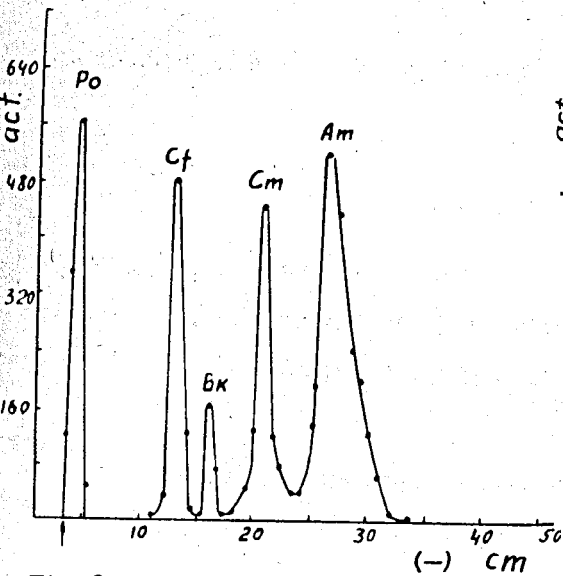

Fig. 2. Separation of Po , Cf , Bk , Cm , Am , $\Delta V = 30$ v/cm, $pH = 1.74$, 15°C, [EDTA] = $2.69 \cdot 10^{-4}$M, 120 min.

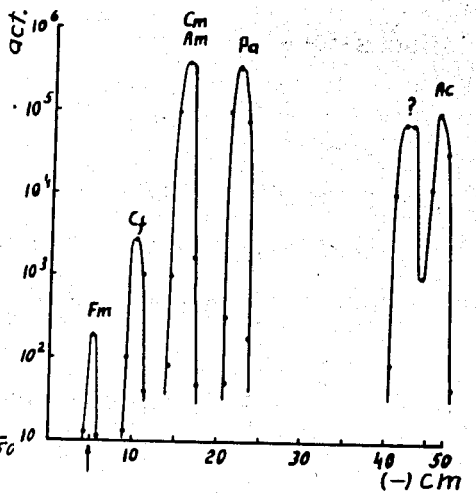

Fig. 3. Separation of the nuclear reaction products in the bombardment $^{243}Am + ^{22}_{0}Ne$. $\Delta V = 30$ v/cm, $pH = 1.74$, 15°C, [EDTA] = $2.69 \cdot 10^{-4}$M, 55 min.

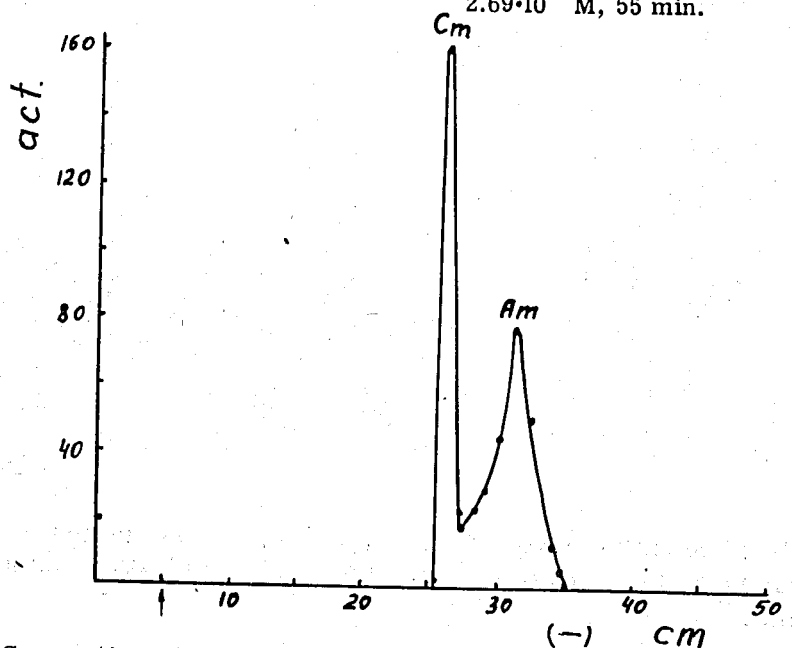

Fig. 4. Separation of Am and Cm in [CDTA] solution. $\Delta V = 30$ v/cm, $pH = 2.10$, 15° C, [CDTA] = $2.76 \cdot 10^{-4}$M, 60 min.

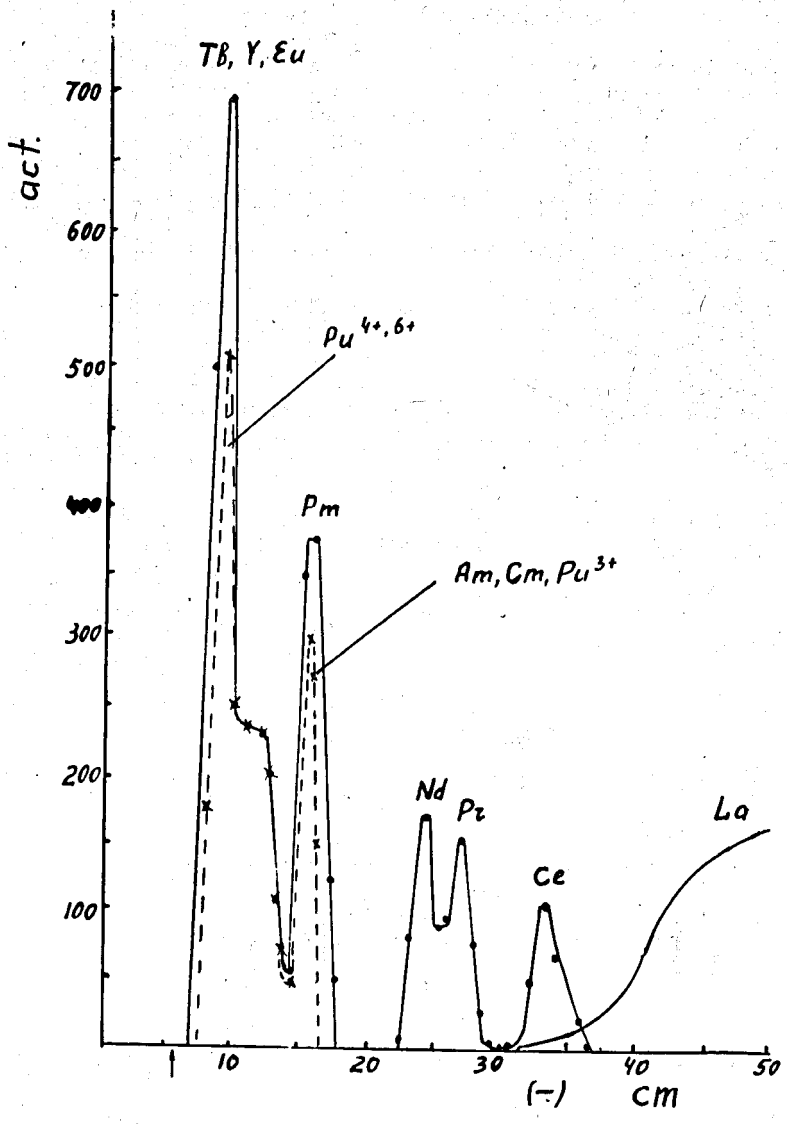

Fig. 5. Separation of Pu , Am , Cm traces and 10 mg of La by thin-layer electrolysis. ΔV =24 v/cm, pH = 1.77, 50°C, [EDTA] = $2.69 \cdot 10^{-4}$ M, 35 min.