ELECTROPHORETIC SEPARATION OF CARRIER-FREE RADIONUCLIDES

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The electrophoretic separation of radioactive rare earths on Cellogel in \( \alpha \)-hydroxyisobutyric acid is described. Minute amounts of radioactive daughter nuclides are separated from the neutron-irradiated rare earth target materials, the ratio of the substances being \( 10^5 : 1 \) to \( 10^7 : 1 \). The suggested method is simple, rapid and suitable for analytical purposes.

For the investigation of short-lived radioisotopes and for the rapid separation of small amounts of radioactive substances, electrophoretic methods have been developed using complexing agents for electrolytes and employing special supporting materials. For the electrophoretic separation of the rare earth elements hydroxy acids were found to be very useful electrolytes\(^1-^6\); thus excellent results were obtained with \( \alpha \)-hydroxyisobutyric acid. Jokl et al. achieved effective electrophoretic separations using \( \text{N-(2-hydroxyethyliminodiacetic acid)}^7\). As previously mentioned,\(^4\) acetylcellulose (Cellogel\(^*)\) proved to be a very good supporting material especially for the electrophoretic separation of trace amounts of substances, such as carrier-free radionuclides. These could be separated from a rather large amount of other materials, such as irradiated targets. Carrier-free radioactive rare earths are obtained by the fission of uranium, or by the irradiation of rare earths with thermal neutrons in a nuclear reactor. In the decay of some of the rare earth isotopes, radioactive daughter nuclides are produced.

This paper deals with the separations of lanthanides present in a ratio of about \( 10^5 : 1 \) to \( 10^7 : 1 \). Previous results and the electrophoretic technique have been described in other papers.\(^8,^9\)

Separation of europium-155 from neutron-irradiated samarium

By irradiating samarium with thermal neutrons, europium-155 is produced:

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\begin{align*}
_{62}^{154}\text{Sm(n, } \gamma \text{)} & \rightarrow_{23\text{ min}} \rightarrow_{1.7a} \rightarrow_{1.7a} \rightarrow_{1.7a} \\
_{62}^{155}\text{Sm} & \rightarrow_{1.7a} \rightarrow_{1.7a} \rightarrow_{1.7a} \\
_{64}^{155}\text{Eu} & \rightarrow_{1.7a} \rightarrow_{1.7a} \rightarrow_{1.7a} \\
_{64}^{155}\text{Gd} & \rightarrow_{1.7a} \rightarrow_{1.7a} \rightarrow_{1.7a}
\end{align*}
\]

* Chemetron Chimica, Milano.
The half-life of europium-155 is rather long and therefore prolonged irradiation is necessary. The samples were irradiated for more than six months in a nuclear reactor Type TRIGA MARK II. This is equivalent to 554 hours at a neutron flux of $1.7 \cdot 10^{12} \text{n cm}^{-2} \text{sec}^{-1}$. After 14 days when the highly radioactive samarium-153 had decayed, the electrophoretic separation was performed, and the Cellogel strip was again irradiated with thermal neutrons to produce some radioactive samarium, which could be detected by autoradiographic methods. Fig. 1 shows the autoradiograms and the $\gamma$-spectra. The $\gamma$-spectrum of the europium spot and the spectrum of a standard sample consisting of neutron-irradiated natural europium are also shown.

![ Autoradiograms and spectra](image)

Fig. 1. Electrophoretic separation of europium and samarium. (0.8 M $\alpha$-hydroxyisobutyric acid, 60 V/cm, 34 min.) a) Autoradiogram after the separation. b) Autoradiogram after separation and subsequent irradiation with thermal neutrons. c) $\gamma$-spectrum of the separated europium-155. d) $\gamma$-spectrum of neutron-activated natural europium: europium-152 and europium-154 are obtained. e) The overlay of spectra c) and d)