NOTIZEN

Identification of Thorium-236

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(Z. Naturforsch. **28 a**, 541 [1973]; received 5 February 1973)

The new nuclide ^{236}Th has been produced via the (γ, 2 p) reaction by irradiation of ^{238}U with 140 MeV bremsstrahlung. After chemical separation of thorium, the half-life was determined to be 36 ± 3 min from the growth-decay curve of the strongest γ-ray transition of the daughter nuclide, 9 min ^{236}Pa.

One possibility for the production of neutron-rich nuclei is the (γ, 2 p) reaction, as previously demonstrated for light elements [1]. The aim of this work was to study the applicability of this type of reaction in the heavy mass region. Specifically, we looked for the production of the still unknown isotope ^{236}Th via the ^{238}U(γ, 2 p)^{236}Th reaction. The heaviest isotope of thorium established until now is ^{235}Th, first produced by the ^{238}U(n, α)^{235}Th reaction [2]. In bombardments of ^{238}U with a bremsstrahlung beam of high energy and high intensity, we were able to identify the ^{236}Th through its genetic relationship with the well-known daughter product [3] 9.1 min ^{236}Pa formed in the β^--decay of ^{236}Th.

The targets, consisting of 4 g of ^{238}U in the form of uranyl nitrate, were subjected to one hour bremsstrahlung irradiations. The bremsstrahlung spectrum having an end point energy of 140 MeV was produced by bombarding a thick copper target with electrons from the Mainz linear accelerator. The thorium was radiochemically separated from the target and the other spallation and fission products in a two-step-procedure. In the first step it was separated by partition between theonyltrifluoroacetone and dilute hydrochloric acid. After elution with 1.5 M HCl from the organic reagent it was purified in a second step by extraction with HDEHP (di-2-ethylhexyl-ortho-phosphoric acid) from strong hydrochloric acid. With this separation procedure, described in more detail elsewhere [4], no contamination from fission products and especially from protactinium isotopes could be observed. The γ-ray spectra were measured with a 35 cc Ge(Li) detector (2.1 keV FWHM at 1333 keV). The couting period commenced 10 minutes after the end of bombardment.

For the mass assignment and determination of the ^{236}Th half-life, the genetic relationship to the well-known [3] 9.1 min ^{236}Pa has been used. This facilitated the differentiation between ^{236}Th and the lighter thorium nuclides formed under the described irradiation conditions by (γ, 2 p x n) reactions having higher cross sections. An analysis of the growth-decay curve (shown in Fig. 1) of the strongest γ-ray of ^{236}Pa at 642 keV yields a half-life of 36 ± 3 min for ^{236}Th. In addition, a half-life of 9 ± 1 min is deduced for ^{236}Pa which is in agreement with the half-life obtained in direct decay measurements [3]. In Fig. 1 the straight lines, representing the decay of the protactinium daughter and of the thorium parent, intersect at the separation time of Pa and Th. This demonstrates the internal consistency of the decay curve analysis. However, because of the small activities of ^{236}Th produced we were unable to discover any γ-rays associated with the decay of this nuclide.

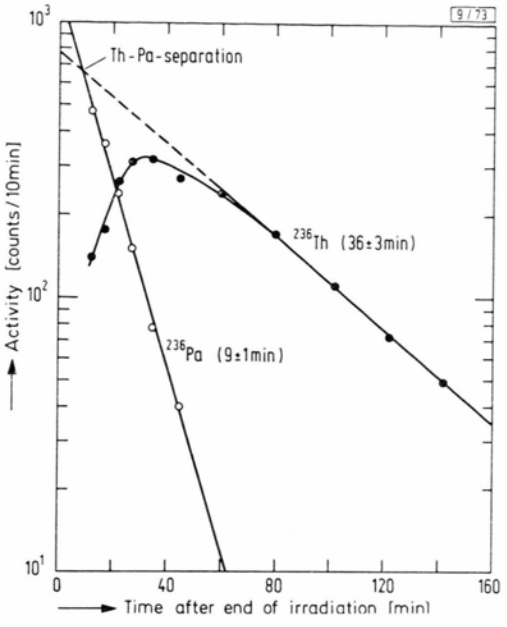

Fig. 1. Determination of the half-life of ^{236}Th by following the growth-decay curve of the 642 keV γ-line of the daughter nucleus ^{236}Pa.

The authors are indebted to Prof. G. HERRMANN for his interest in this work, and to Prof. B. ZIEGLER and his coworkers for irradiations with bremsstrahlung. We wish to thank des Bundesministerium für Bildung und Wissenschaft for financial support.

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[1] W. GRIMM and W. HERZOG, Z. Naturforsch. **26 a**, 1933 [1971].
[2] N. TRAUTMANN, R. DENIG, and G. HERRMANN, Radiochim. Acta **11**, 168 [1969].
[3] N. TRAUTMANN, R. DENIG, N. KAFFRELL, and G. HERRMANN, Z. Naturforsch. **23 a**, 2127 [1968].
[4] N. KAFFRELL and N. TRAUTMANN, to be published.