Title	Cyclotron production of ^{167}Tm from natural erbium
Sub Title	
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Publisher	共立薬科大学
Publication year	1979
Jtitle	共立薬科大学研究年報 (The annual report of the Kyoritsu College of Pharmacy). No.24 (1979.) ,p.89- 90
JaLC DOI	
Abstract	
Notes	抄録
Genre	Technical Report
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AN00062898-00000024-0089

Cyclotron Production of ^{167}Tm from Natural Erbium*

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Since the advantages of several rare earth isotopes as HEDTA (Hydroxy ethylene diamine tetra acetic acid) chelates were first pointed out in 1969, ^{167}Tm-HEDTA complex has attracted considerable interest. Hisada and Ando found in their mouse tumor model studies that thulium had a higher tumor uptake than did gallium. Recently it was pointed out by Chandra *et al.* that ^{167}Tm which has a half-life of 9.8 days and emits a prominent γ-ray of 208 keV energy is significantly better for bone scanning than ^{85}Sr on the basis of detectable photons for a given radiation dose to the patient. Additional advantages of the ^{167}Tm is that the isotope is suitable for commercial manufacture with strict quality control, shipping and reasonable storage. Chandra *et al.* prepared ^{167}Tm by the reaction ^{167}Er (p, n) ^{167}Tm. However, this cyclotron production of ^{167}Tm has involved problems arising from relatively low yield of ^{167}Tm (75 μCi/μAhr) and the use of expensive 93% enriched erbium oxide targets. Scholz *et al.* produced ^{167}Tm by bombarding Lu, Hf, Ta and W with 590 MeV protons. The limitation of this nuclear reaction is that the required particle energies are not attainable with some compact cyclotron. This work was initiated to explore the possibilities of producing high-purity ^{167}Tm by ^{3}He and ^{4}He reaction on natural erbium target.

Erbium oxide of 2.0×2.0 cm^2 a surface density of 2.50 mg/cm^2 was melted on iron foils and encapsuled in alminium foils. About ten to fifteen of these targets were stacked on a brass target holder and bombarded 1 μA beam of 40 MeV ^{3}He and ^{4}He particles from the IPCR cyclotron. Identification and assay of gamma-ray-emitting nuclides were carried out using a spectrometer consisting of an intrinsic Ge detector with a 4096-channel pulse height analyzer.

The bombardment of $Er_2O_3$with 40 MeV ^{3}He produced, ^{165}Tm, ^{166}Tm, ^{167}Tm, ^{168}Tm, ^{166}Yb and ^{169}Yb. The ^{165}Tm and the ^{166}Tm can be allowed to decay to insignificant levels, waiting period of three and ten days are recommended, while the ^{166}Yb and ^{169}Yb can be separated from target chemically, therefore the only thulium radionuclide that poses any problem as a contaminant is ^{168}Tm. The thicktarget yield of ^{168}Er (^{3}He, p3n) ^{167}Tm was 81 μCi/μAhr at ^{3}He bombarding energy of 40 MeV. However the ^{168}Tm contamination in ^{167}Tm was 3.7% at the end of the bombardment.

On the other hand, the thick-target yield of ^{167}Tm obtained was 32 μCi/μAhr at ^{4}He

* 本報告は *Int. J. appl. Radiat. Isotopes* (in press). に発表。

bombarding energy of 40 MeV, while the troublesome ^{168}Tm contamination in the final preparation was 0.9% of ^{167}Tm. Comparison of the excitation and the thick-target yield curve for the ^{168}Er (^{3}He, p3n) ^{167}Tm with the reaction Er (^{4}He, pxn) ^{167}Tm show that a higher radionuclidic purity of ^{167}Tm may be expected from ^{4}He than ^{3}He bombardment of natural erbium.