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Excitation Functions and Yields of ^{87m}Y and Preparation of a ^{87m}Sr Generator*

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The advantages of generators for the production of ^{87m}Sr have been attracted considerable interest. Its 2.81 hr half-life and a monoenergetic gamma-ray of 388 keV with 17.5 per cent internal conversion make it a ideally suited radionuclide for *in vivo* studies of calcium metabolism by the absence of any suitable radionuclide of calcium. Recently it was pointed out by Chandra et al. that ^{167}Tm is significantly better for bone scanning than ^{87m}Sr on the basis of detectable photons for a given absorbed radiation dose to the patient. It should be emphasized, however, that the properties of strontium are in many respects similar to those of calcium and may therefore be used not only as bone scanning agent but as tracers, with limitations, for some of the physiological processes in which calcium is normally involved.

In order to maximize the yield of $^{87m}Y \rightarrow ^{87}Y$ and minimize the yields of other undesirable radionuclide, it is necessary to measure the excitation functions of ^{87m}Y and possible contaminants. Among the radionuclides from ^{3}He and ^{4}He bombardment of Rb target, ^{85m}Y has a 2.7 hr half-life and decays to ^{85}Y which in turn with a 5.0 hr half- life to ^{85m}Sr. Therefore ^{85m}Y may pose a problem if it is not eliminated, although it has not been reported in the past.

Finely ground rubidium chloride of 2.0×2.0 cm^2 a surface density of 2.35 mg/cm^2 was melted on iron foils (15.38 mg/cm^2) and encapsuled in alminium foils (4.50 mg/cm^2). About ten to fifteen of these targets were stacked on a brass target-holder with water cooled pipes.

Bombardment of the Rb target was carried out with a 0.5 μA beam 40 MeV ^{3}He particles from the IPCR cyclotron, or a 0.3 μA beam of 60 MeV ^{4}He particles from the NIRS cyclotron. The duration of the bombardment 30 and 40 min, respectively. A Q-magnet and a collimator situated in front of the target reduced the spread in width of beam ca. 1.5×1.5 cm^2. The beam current was measured with a beam current integrator.

About an hour after the bombardment the targets were measured with an intrinsic Ge detector (Princeton Gamma-Tech Inc.) coupled to a 4096-channel analyzer. This system had a 1.98 keV resolution (FWHM) at 1.33 MeV and a peak-to-Compton ratio of 32:1. The detector was absolutely calibrated using a set of IAEA γ-ray standard sources. The principal photopeaks of nuclide were followed in order to determine the half-life and confirm the identity of the nuclides. The dead time losses were always less than 10%.

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The bombardment of RbCl with 40 MeV ^{3}He produced ^{85m}Y, ^{86m}Y, ^{87m}Y and ^{88}Y by the (^{3}He, xn) reactions. ^{86m}Y and ^{88}Y decay to stable strontium ^{86}Sr and ^{88}Sr, respectively. This means that for the ^{87}Y–^{87m}Sr generator which keep yttrium effectively on an anion-exchanger resin, ^{86m}Y and ^{88}Y cause no problem. The thick-target yield of ^{85}Rb (^{3}He, 3n) ^{87m}Y reactions was 100 μCi/μAhr at ^{3}He bombarding energy of 40 MeV. In our estimation, however, ^{85m}Y contamination in ^{87m}Y was 69% an hour after the end of the bombardment. On the other hand, the thick-target yield of ^{87m}Y with $E\alpha$=60MeV went up to 3.1 mCi/μAhr. However, the radionuclidic impurity of ^{85m}Sr in ^{87m}Sr, which was calculated from the level of ^{85m}Y produced simultaneously with ^{87m}Y, also increased at ^{4}He bombarding energies above 35 MeV. Consequently in order to eliminate the ^{85m}Sr content of the final preparation, the energy of the incident ^{4}He particle should be controlled at 35 MeV. ^{87m}Sr yield at 35 MeV normalized to target weight 133 mg was 1.7 mCi/μAhr, which is sufficient quantities to carry out radiopharmaceutical studies.