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Preliminary study on ion exchange absorber for the development of $^{82}Sr/^{82}Rb$ generator

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1. Introduction

Several radioisotopes such as ^{13}N, ^{15}O, ^{99m}Tc, ^{201}Tl and ^{82}Rb are used to diagnose coronary artery disease.

Among these radioisotopes, ^{82}Rb and ^{99m}Tc can be conveniently obtained from generators [1]. The advantage of radioisotope generators is an inexpensive and simple to produce short-lived radioisotope compared to on-site cyclotrons. ^{82}Rb, a β^{+} emitter with an ultra-short half-life of 75 sec, allows positron emission tomography (PET) imaging. According to several reports, ^{82}Rb-PET have shown superior diagnostic performances like image quantification with high resolution and sensitivity as compared to conventional single photon emission computer tomography (SPECT) using ^{99m}Tc [2].

A medical radioisotope ^{82}Rb is generator-produced from its parent radioisotope ^{82}Sr. The half-life of ^{82}Sr is 25.5 days, which results in a generator life of 6 to 8 weeks [3]. Preparation of the ^{82}Sr parent is difficult, because appropriate specifications of the product is essential in routine generator production. However, our research group already reported that Sr of high purity to meet appropriate specifications was prepared by an optimized purification method [4]. Currently, we are trying to establish the basic manufacturing technique of $^{82}Sr/^{82}Rb$ generator as a follow-up study. To select the appropriate ion exchange absorber in generator system, various studies on absorber were conducted.

2. Methods and Results

2.1 Conceptual Design of $^{82}Sr/^{82}Rb$ generator

We drew a schematic diagram of 82 Sr/ 82 Rb generator before making a prototype of generator. Schematic diagram of 82 Sr/ 82 Rb generator is shown in Fig. 1.

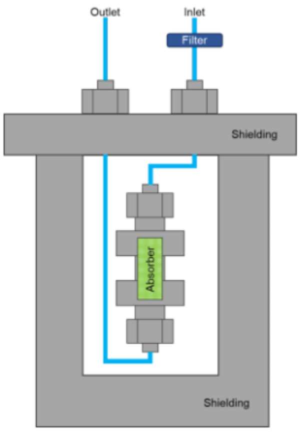

Fig. 1. Schematic diagram of $^{82}Sr/^{82}Rb$ generator including inlet with filter, outlet, ion exchange absorber, and a thick shielding.

$^{82}Sr/^{82}Rb$ radioisotope generator consists of four components such as inlet line with filter, outlet line, column filled with Sr absorber, and lead shielding for blocking scatter radiation.

2.2 The adsorption of ^{82}Sr into the generator column

All experiments are performed using cold stock solution (10 µg of Sr in 0.1 M HCl, 10 µg of Rb in 0.1 M HCl).

The Tin(IV) oxide ion exchanger, approximately 4 g, was incubated overnight with 50 mL of 0.1 M NH 4 OH/NH 4 Cl buffer and 20 mL of 2 M NaCl in order to activate its ion exchange abilities. The Tin(IV) oxide was then loaded in the empty column. The Tin(IV) oxide was saturated with Na^{+} ion by passing 120 mL of 2 M NaCl through the column at a flow rate of 0.5 mL/min followed by 300 mL saline at a flow rate of 5 mL/min. The adsorption of the generator with ^{82}Sr in pH 7.4 Tris-HCl buffer is carried out by passing the cold stock solution at a flow rate of 0.05 mL/min.

Adsorption rate of ^{82}Sr is dependent upon characteristics of ion exchange absorber [5]. Various conditions such as the size of Tin(IV) oxide, buffer pH, and reaction temperature were investigated to select an adequate condition for use in the generator. Table I lists Experimental results on various conditions.

Table I. Some conditions for the adsorption of ^{82}Sr into the generator column and results on loading yield of Sr

Tin(IV) oxide size (µm)	pH	Temperature (°C)	Loading yield (%)
250 ~ 500	7	50	76.7
250 ~ 500	8	50	76.6
125 ~ 250	10	RT[a]	74.5
250 ~ 500	10	RT	64.2
1000 >	10	RT	58.6

[a]RT : room temperature

Higher yield (>95%) of the adsorption of ^{82}Sr is a prerequisite of the adequate column material for $^{82}Sr/^{82}Rb$ generator [6]. Our current results are insufficient for applying in $^{82}Sr/^{82}Rb$ generator. Since there might be a chance that meta-stannic acid works as well, no ion-exchange reaction was happened [7]. So we are still trying to increase the adsorption yield of ^{82}Sr into the generator column.

3. Conclusions

We proposed conceptual design of $^{82}Sr/^{82}Rb$ generator and performed a preliminary study on ion exchange absorbent with various conditions. In future study, we plan to find satisfying column conditions for use in the generator system.

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