Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 18-19, 2023

Purification and Recovery of Lu using Chromatography

Hyojin Kim[*,**], Kanghyuk Choi[**]
Chemistry, Hanyang University, Seoul, Korea[*]
Radioisotope Research Division, Korea Atomic Energy Research Institute, Daejeon, Korea[**]
E-mail : khchoi@kaeri.re.kr

1. Introduction

Lutetium(Lu) is the last element in the lanthanide series, which is can be used in metal alloys and as a catalyst in various chemical reactions. Especially, ^{177}Lu is most famous radioisotope and has recently been mainly used in radionuclide therapy in nuclear medicine.

^{177}Lu can be produced with two different pathway by neutron irradiation. One is direct method by using the ^{176}Lu(n,γ)^{177}Lu reaction, and the other is indirect method by using ^{176}Yb(n,γ)^{177}Yb → ^{177}Lu reaction. In direct process, carrier ^{176}Lu are mixed and by-products ^{177m}Lu are produced. To produce no-carrier added (n.c.a.) ^{177}Lu that has high specific activity and high radionuclide purity, indirect process must be used.

As the demand of lanthanide nuclides (including ^{177}Lu) increases, numerous researchers have devoted themselves to developing high purity isotopes. The purification is also necessary to use in medical fields.

To get a high purity ^{177}Lu via ^{176}Yb(n,γ)^{177}Yb → ^{177}Lu reaction, two steps are required; separation process and purification process. Lu-177, undergone the separation process, contains a large amount of organic materials(e.g. HIBA, amine) and requires purification process. For removal of organic materials, the methods for heating the solution or for a column chromatography can be suggested. Between 2 conditions, the purification process using column chromatography is suitable for purification within limited time.

After purification of Lu using a Sep-Pak column, an identification process is needed. Because Lu ions have transparent color in water and are difficult to distinguish with naked eyes, a coloring agent is used that reacts with metal ions and changes color.

The colorless lanthanide can be detected through the on-line detection system using a chromogenic complexing reagent. Because of on-line detection system with coloring agent, many experiments in a variety of conditions can be easily conducted, such as changing the dilution ratio, amounts of samples, concentration of washing eluent, type of resin and so forth.

In this study, we will discuss the recovery conditions of Lu with cold state loaded into a Sep-Pak and real-time metal ion detection using chromatographic method.

2. Experiments

2.1. Materials

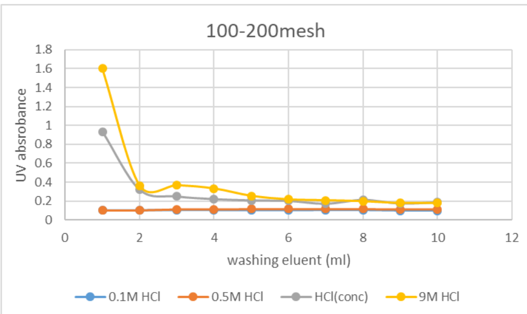
0.07M α-HIBA (α-hydroxyisobutyric acid) adjusted to PH 4.2 with methyl amine and 0.2mM PAR[4-(2-pyridylazo) resorcinol], glacial acetic acid, ammonium hydroxide, 50w-x8 cation exchange resin 100-200mesh and 200-400mesh with the H^+ form.

2.2. Purification of Lu

Sample including 0.25 mg of Lu(cold) was loaded into the prepared 0.5ml Sep-Pak column under 0.07M α-HIBA condition. After loading, the Sep-Pak was washed using two peristaltic pumps in the order of 0.1M HCl, 0.5M HCl and 9M HCl (or conc HCl). Then, washing solution was mixed with PAR and the UV absorbance at 510nm was measured using a UV-vis spectrophotometer at every 5 sec for 30 sec. Then, the amount of Lu eluted is determined by substituting the absorbance into the calibration curve plotted with standard solutions.

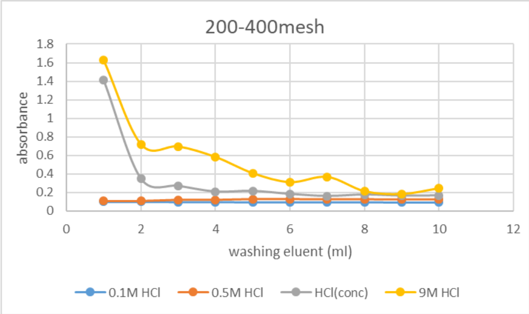
3. Results and Discussion

This study evaluated the recovery yield of Lu according to the concentration of HCl and type of resin and appropriate dilution ratio. The absorbance according to amount of washing eluent was checked and plotted the absorbance like below.



Washing eluent	recovery yield(%)
Conc HCl	23.32
9M HCl	51.26

Fig. 1. Chromatogram of washing of Lu by HCl and recovery yield (0.5ml Sep-Pak packed with 50w-x8 100-200mesh resin)



Washing eluent	recovery yield(%)
Conc HCl	39.10
9M HCl	90.24

Fig. 2. Chromatogram of washing of Lu by HCl and recovery yield (0.5ml Sep-Pak packed with 50w-x8 200-400mesh resin)

4. Conclusion

Overall, a higher concentration of HCl and a higher mesh size of the resin tended to result in higher UV absorbance at 510nm. However, it was observed that Lu eluted more in 9M HCl compared to conc HCl.

The conditions for purification and recovery found in this experiment with cold state is expected to be applicable to the n.c.a. radio lanthanide such as ^{176}Yb. In the near future, the studies for isotope recovery with radioactive materials will be carried out.

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