

Separation of no-carrier added radiolanthanides from neutron-irradiated metal oxides

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1. Introduction

Radiolanthanides are important therapeutic radionuclides in nuclear medicine due to its high theranostic potential. The no-carrier added (n.c.a.) radiolanthanides have high specific radioactivity and high radionuclidic purity without the long-lived radionuclidic impurity. The nca ^{177}Lu , for example, can be produced *via* neutron capture (n, γ) of ^{176}Yb target as an indirect production and subsequent β^- decay of produced ^{177}Yb ($t_{1/2} = 1.91$ h), as follows: $^{176}\text{Yb}(n, \gamma)^{177}\text{Yb} \rightarrow ^{177}\text{Lu}$ [1,2]. Subsequently, radiochemical separation is a critical process because it requires a sophisticated technique to separate ^{177}Lu from an abundant target with adjacent atomic number.

To find out the optimal methods for the separation of n.c.a. radionuclide, numerous researchers have devoted themselves. Some researchers conducted research on producing n.c.a. Lu-177 by using electrochemical amalgamating method, some conducted research using chromatography. In the 2000s, many researchers agreed that chromatographic methods were more useful than amalgam forming methods.

After column separation of each metal ion with non radioactives, the identification process is needed. Generally, after obtaining the fractions at fixed time-intervals, each fraction was identified by using AAS or ICP AES, because almost all lanthanide ions have transparent color in water and are difficult to distinguish with naked eyes. The identification with each fraction may have main two disadvantages. The first is that it takes a lot of time for identification process of fractions, and the second is that exact elution time of metal ions could not be identified.

To overcome these disadvantages, coloring agents, which react and change the color with lanthanides, is connected to the end of column and the separated solution is checked at real time. To use this methods, many studies can be conducted in a limited time without radio tracers. Also, no radioactive wastes are generated, because it is tested with stable compounds.

The colorless lanthanide can be detected through the on-line detection system using a chromogenic complexing reagent at the rear the LC column [3]. Therefore, owing to the on-line detection system with coloring agent, many experiments can be easily conducted under many conditions, such as changing the

column size, eluents, column materials, the amounts of samples and so forth.

2. Experiments

2.1. Materials

α -HIBA (α -hydroxyisobutyric acid) and PAR (4-(2-pyridylazo) resorcinol), were purchased from TCI. Ammonium hydroxide and glacial acetic acid were purchased from Daejung Chemicals and Merck, respectively.

Cation exchange resin in the H^+ form was purchased from Benson Polymeric Inc.

2.2. LC system with the post-column reaction detection

The LC instrument was consisted of a high pressure pump and a six-port Rheodyne valve equipped with sample loop of 500 μl . The LC column was prepared by packing the cation exchange resins into Eco Plus glass column (YMC). The lanthanide sample was injected into the mobile phase HIBA. The eluted metal ions were mixed in a mixing-tee with the post-column reagent added using a pump with a flow rate of 0.5 ml/min. Then, the mixed solution was monitored using a UV-vis spectrophotometer (Agilent 8453) through the flow cell. (Fig. 1)

2.3. Separation of stable isotope metal oxides

0.5 ml of sample, including stable isotope metal oxides, was injected into the prepared column under isocratic condition. At the same time, post column reagent was eluted to the mixing-tees by operating pump. Then, the mixed solution was measured using a UV-vis spectrophotometer at an interval of 30 s or 1 min.

3. Results and Discussion

In the separation study using stable isotopes, on-line detection with post-column reagent makes it possible to find the optimum separation conditions in a short time. In addition, this research provide a lot of information such as the effects of the concentration and pH of eluent α -hydroxyisobutyric acid, the type and size of resin on the separation efficiency, without producing radioactive waste. Furthermore, the conditions for separation of adjacent ions found in this system can be applied to the nca radiolanthanide separation from the neutron-

irradiated metal oxide target, resulting in very similar results. The more detail process will be discussed in this presentation.

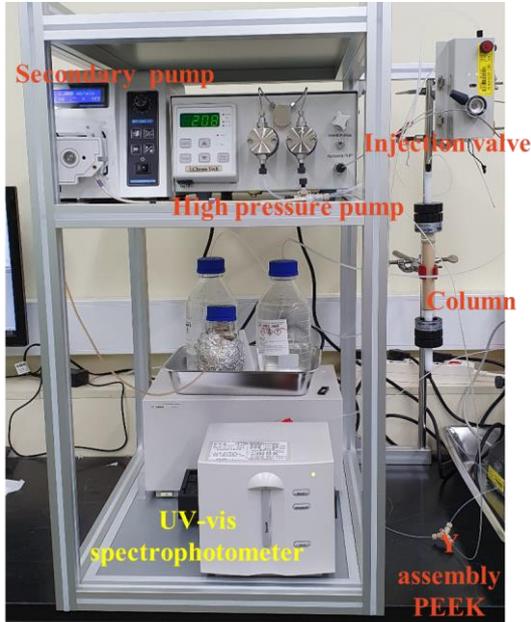


Fig. 1. Photographs for LC system with the on-line detection.

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