Method of Separating Carrier-Free Ho-166 and Purification using Chromatography

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Introduction

Stable isotopes
Mo-98, Te-130, Lu-176, Ho-165 etc.

Radioisotopes
Tc-99m, I-131, Lu-177, Ho-166 etc.

Medical Applications

^{166}Ho
- beta radiation : *treatment of cancer*
- gamma radiation : *imaging*

Radiotherapeutic properties

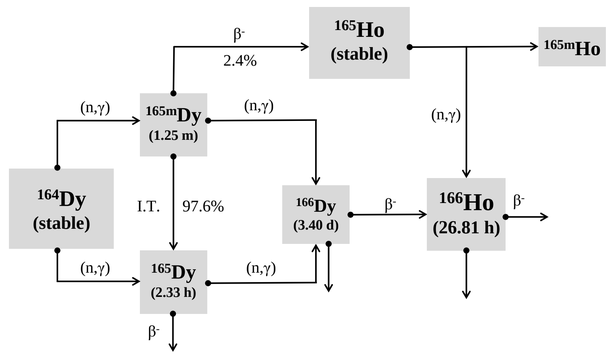
► Production methods available

- The "direct" technique with carrier: ^{165}Ho(n, γ)^{166}Ho
  [By-product ^{166m}Ho ($t_{1/2}$=1200y)]
- The "indirect" technique without carrier
  : ^{164}Dy(n, γ)^{165}Dy(n, γ)^{166}Dy $\xrightarrow{\beta^-}$ ^{166}Ho
  Need to separate Ho from Dy mixture

	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
Ion radius (pm)	103	101	99.0	98.3	97.0	95.8	94.7	93.5	92.3	91.2	90.1	89.0	88.0	86.8	86.1

*Separation of Ln has been achieved by ion-exchange chromatography with **cation-exchange resin** and **complexing agent**.*

► Nuclear Reaction of Dy-164 target



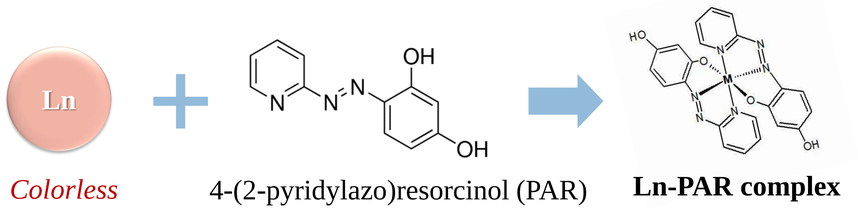
In order to obtain carrier free Ho-166, the separation is carried out first, and secondary separation should be performed after the time laps for new radioactive equilibrium.

Experiment and Results

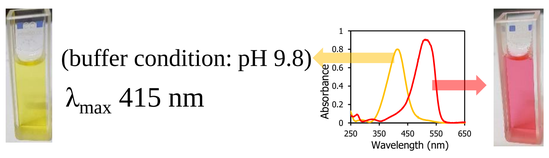
► Separation of Dy and Ho in Cold State

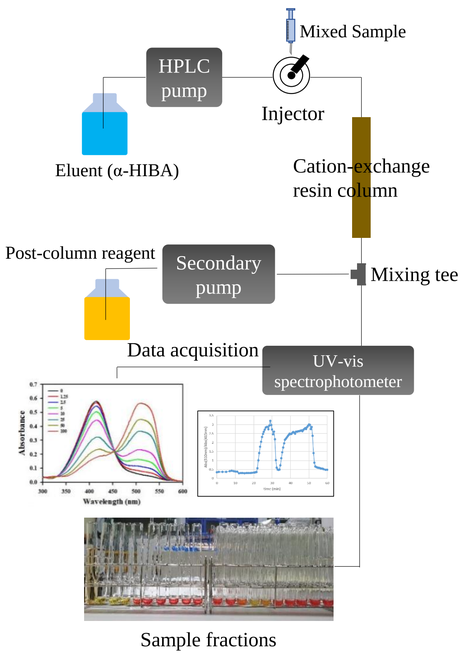
: Real-time evaluation technique for optimal separation conditions

Post-column reactions are based on spectrophotometric measurement for the chemical reaction between the appropriate chromogenic complexing agent, the so-called post-column reagent, and the metal after the sample is eluted from the column.



Colorless 4-(2-pyridylazo)resorcinol (PAR) **Ln-PAR complex**

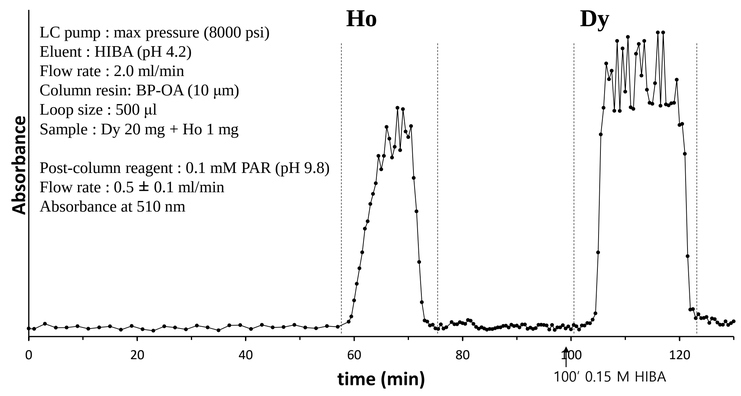




HPLC instrument with post-column reaction system components

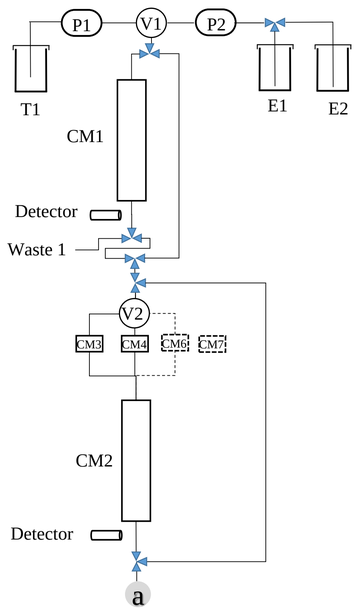
Separation of lanthanide ion onto the column was **confirmed by on-line monitoring** of the effluent using post-column derivatization reagent (chromogenic complexing reagent).

→ radioactive waste ↓
→ provides a variety of information including column reuse and reproducibility within a short time.

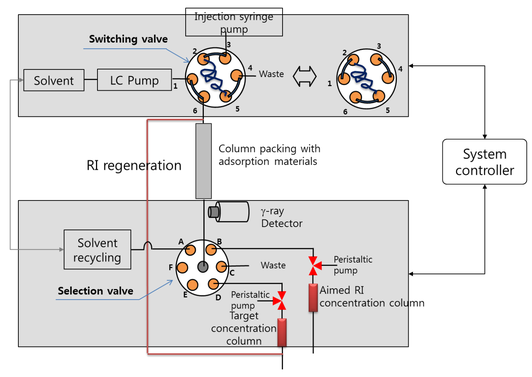


► Separation of Ho-166

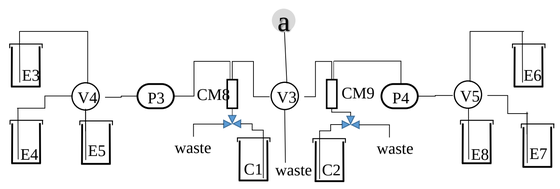
Separation process



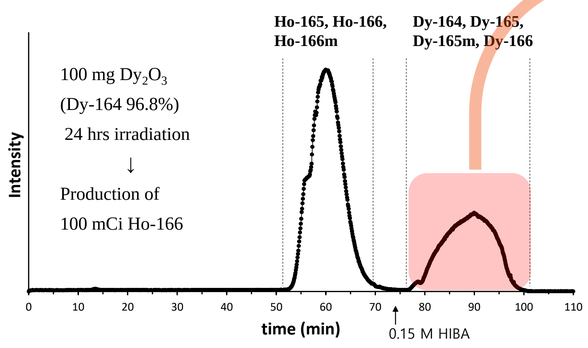
Conceptual diagram of RI separator



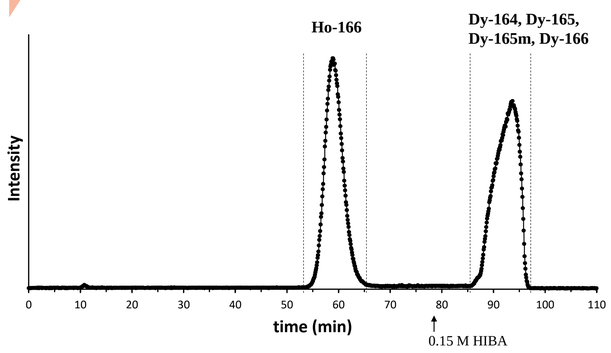
Purification process



1st separation for obtaining the pure Dy

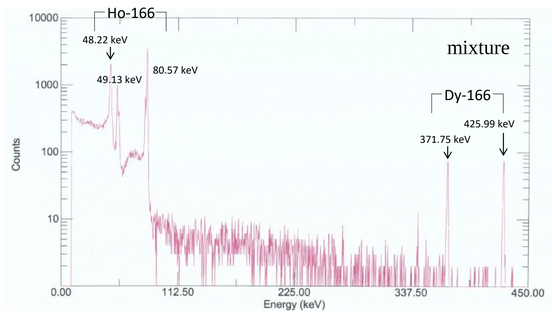


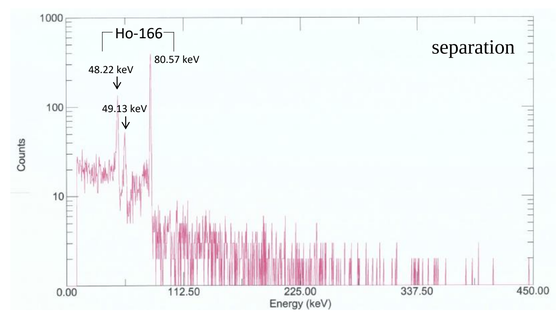
2nd separation



The **first step** is to perform the first column (CM1) separation to obtain the Dy-fraction after melting the irradiated target (Dy target). The **second step** is to collect n.c.a Ho-166 through the secondary column (CM2) separation after radioactive equilibrium is established. The obtained Ho mixture is subjected to washing process and drying to obtain carrier free Ho.

Gamma ray spectrum





Conclusion

► Post-column reaction system was introduced for real-time check the cold separation, and this systems provide a number of data for produce carrier-free RI.
► Post-column reaction system provides a lot of information while reducing radioactive waste.
► Carrier-free Ho-166 was obtained through column separation in two steps. The first step is to obtain the Dy-fraction after melting the irradiated target (Dy target), followed by a second separation after a time lap for new radioactive equilibrium.