

Liquid-liquid solvent extraction of group 6 elements with α -benzoinoxime

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Abstract – Short-lived ^{101}Mo in hydrochloric solution have been extracted with α -benzoinoxime- CHCl_3 . MoO_2^{2+} stable exists in the media of HCl solution over the concentrations range of 10^{-3} ~3mol/L HCl and can be extracted with high yield into α -benzoinoxime. The extraction equilibrium can be reached within 30 seconds. The test experiment of short-lived W isotopes will be done soon, and the suitable chemical procedure of Sg will be proposed.

Keywords – extraction, Mo/W, α -benzoinoxime

Discovery of long-lived isotopes of element 106, seaborgium (^{265}Sg , $T_{1/2}=7.4\text{s}$ and ^{266}Sg , $T_{1/2}=21\text{s}$) offers possibilities of studying the solution chemistry of Sg[1]. The first chemical studies of Sg revealed chemical properties of a typical group 6 elements[2]. Relativistic effects increase with nuclear charge and could be more pronounced for the heavier seaborgium. Therefore, it is important to investigate whether the chemical properties also vary monotonously in the sequence Cr-Mo-W-Sg in other chemical systems. For the development of chemical systems applicable in fast on-line experiments with transactinides, usually the lighter homologs and pseudo-homologs are tested in model experiments. It is well-known that α -benzoinoxime is a specific reagent for group 6 elements and widely used in the separation of ^{99}Mo from the fission products to manufacture the generator of ^{99}Mo - $^{99\text{m}}\text{Tc}$. Here we reported the liquid-liquid solvent extraction of short-lived ^{101}Mo in the media of hydrochloric acid with α -benzoinoxime. The goal of the research was to check whether this extractant adapt to extract element Sg.

The carrier-free radiotracer of ^{101}Mo ($t_{1/2}=14.6\text{min}$) was obtained from the spontaneous fission (SF) of ^{252}Cf source. A He-jet system was applied to transport the tracers to collection chamber. The fission fragments recoiling from the ^{252}Cf source were stopped in N_2 gas and attached on the KBr aerosol particles in a recoil chamber. In a continuous regime, products were transported along capillaries to the collection chamber in a few seconds. The KBr aerosol particles were deposited on a $50\mu\text{m}$ nickel foil. After collection times of 30min, tracer activities were dissolved in 3 mL of certain concentration of HCl and extracted with equal volume of 4.4×10^{-2} mol/L α -benzoinoxime- CHCl_3 solution. Based on our previously experiments of micro-amounts of Mo, W and tracer amounts ^{99}Mo , the results indicated that the extraction equilibrium has been achieved at 30s. 1min was selected as shaking time in present experiment. Both phases were assayed for 30min by using a HPGe γ -ray detector coupled with a multichannel analyzer in a low background lead room.

The extraction of ^{101}Mo with α -benzoinoxime was studied over the concentration range from 1×10^{-5} ~5 mol/L

HCl. The results are shown in Fig. 1. It can be seen that the extraction yield reaches a maximum of 77% at a concentration of 10^{-3} mol/L HCl and then stays constant until the concentration of HCl achieves 3mol/L. According to the literatures and our additional experimental results, we deduce MoO_2^{2+} species was extracted into organic phase at the present experimental condition. This suggests that positive charged MoO_2^{2+} complex is predominant at 10^{-3} ~3mol/L HCl in the aqueous phase. Because the formation of the negatively charged MoO_4^{2-} at higher acid concentration and the formation of the negatively charged chloride complex at lower acid concentration, the extraction yield decreases in the experiment. Short-lived W isotopes will be produced in the reaction of $^{19}\text{F} + ^{159}\text{Tb}$ at HIRFL (Heavy Ion Research Facility at Lanzhou), and extraction experiment in the same range of the HCl concentrations will be done in near future. Hence, we could choose a proper experimental condition to perform the chemical properties of Sg.

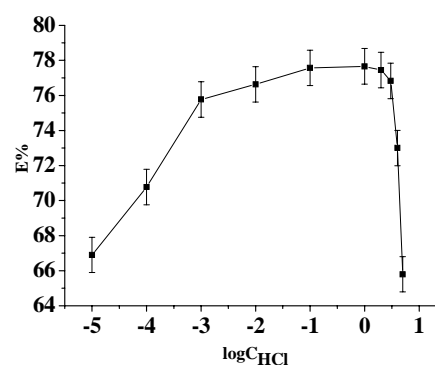


Fig. 1 Extraction of ^{101}Mo into 4.4×10^{-2} mol/L α -benzoinoxime as a function of HCl concentration shaking time: 1min

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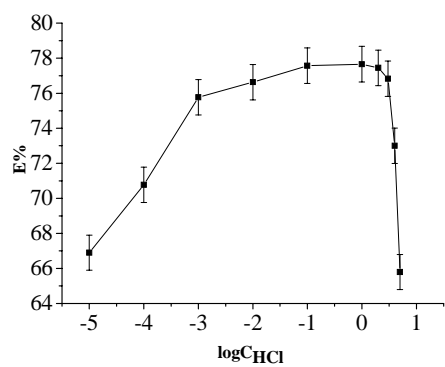


Fig. 1 Extraction of ^{101}Mo into $4.4 \times 10^{-2} \text{ mol/L}$ α -benzoinoxime as a function of HCl concentration shaking time: 1min

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- [1] NRC7 Reference
- [2] NRC7 Reference