

Ion exchange separation of indium and thallium

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Indium and thallium belong to the same group of the Periodic Table of the Elements and are considered to be light homologues of the last member of this group, element 113. This element is the heaviest odd-Z superheavy element (SHE) that has been chemically investigated. There is only one paper published on this topic so far that confirmed element 113 to be volatile and to have weak adsorption on inert surface such as Teflon [0]. The goal of this work is to develop a simple cation exchange procedure for indium and thallium separation with potential application in future liquid-phase SHE experiments.

Strelow *et al.* studied distribution ratios of In, Tl and other elements between Dowex 50x8 resin and HCl/acetone solutions [0]. We chose pure HCl media and a resin with lower cross-linkage (Dowex 50x4) to simplify the process and minimize the volume of each fraction. Also, zirconium and yttrium were introduced to the system to simulate fission and transfer reaction product behavior, respectively, upon element 113 synthesis [0].

Fig. 1 shows isocratic separations of the light homologues of element 113. Recoveries of In and Tl(I) are $(97.9 \pm 0.5)\%$ and $(98.8 \pm 0.8)\%$, respectively. This result provides a good scheme for SHE investigation in aqueous media. Yttrium remains on the column until the HCl concentration is increased up to 3 M with $(97 \pm 4)\%$ recovery. This yttrium fraction can be analyzed in an experiment with element 113 synthesis to represent actinide transfer reaction

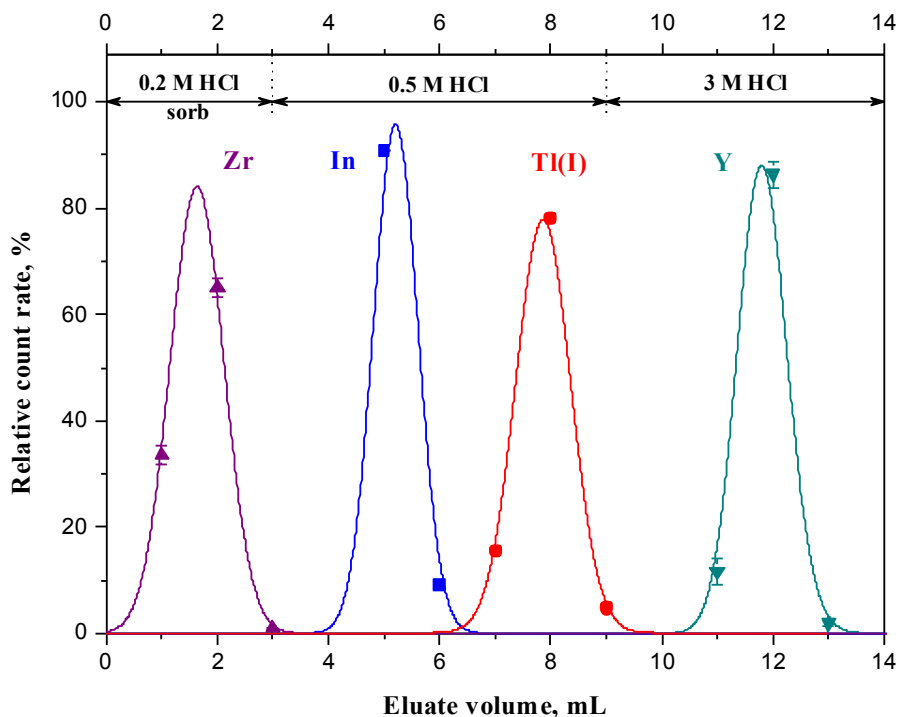


FIG. 1. Separation of Zr, In, Tl(I), and Y (4x80 mm column with Dowex 50x4, 200-400 mesh resin).

products. The zirconium elution position is quite interesting because it should have been strongly adsorbed by the cation exchanger [0]. Based on the shape of its elution curve and $(90 \pm 4)\%$ recovery, we can draw the conclusion that Zr was in the form of a negatively charged compound. The structure of this compound is uncertain because we might deal with chloride and/or oxalate (initial form of Zr product) complexes. Such a hypothesis is confirmed by a previous report [0] that showed large distribution coefficients of Zr on anion exchange resins in the presence of hydrochloric and oxalic acids.

In order to possibly change the elution order of indium and thallium, bromine water was applied to oxidize the latter. Fig. 2 shows stepwise group 13 elements separation and their isolation from zirconium and yttrium. One can see that the Tl(III) and In elution curves are barely overlapped, indicating good peak resolution. Total Tl(III) and In recoveries are $(94.4 \pm 1.0)\%$ and $(79.7 \pm 0.8)\%$, respectively. Lack of full indium elution is probably due to resin degradation because of being in contact with bromine water. Nevertheless, satisfactory separation of Tl(III) and In is achieved within a volume of 8 mL. The behavior of Zr and Y in this experiment is analogous to one described above with $(96 \pm 5)\%$ and $(86.3 \pm 1.8)\%$ recoveries, respectively.

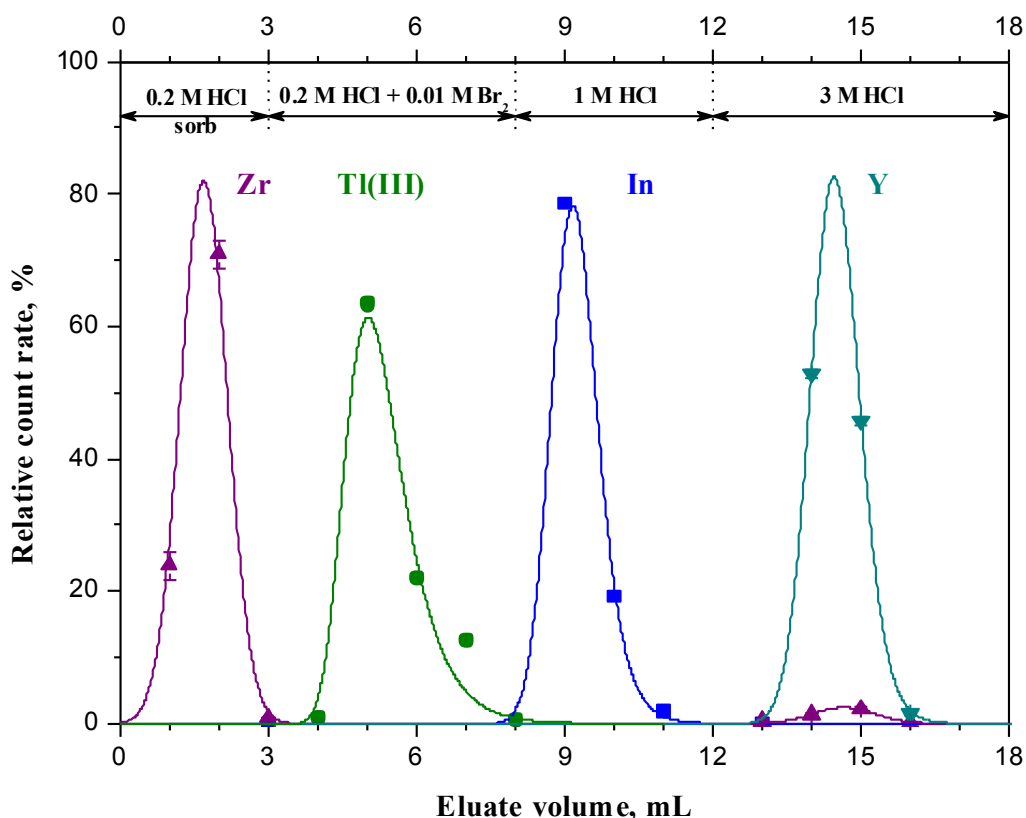


FIG. 2. Separation of Zr, In, Tl(III), and Y (4x80 mm column with Dowex 50x4, 200-400 mesh resin).

These results suggest that this system may be suitable for determining the ion exchange behavior of element 113.

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