

Lithium Isotope Separating Characteristics of Specific Lithium Adsorbents

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Summary

Lithium isotope effects were measured between lithium taken up by adsorbents and lithium in aqueous solutions in equilibrium with each other. The adsorbents studied were: 1) a manganese-oxide-based adsorbent with the spinel structure, derived by extracting lithium from LiMn_2O_4 and designated as $\text{MnO}_2(\text{Li})$; 2) monoclinic antimonite acid obtained by extracting lithium from LiSbO_3 and designated as HSbO_3 ; 3) cubic antimonite acid donated by Toagosei Chemical Industry Co. and designated as IXE-300, and 4) a titanium-zirconium-phosphate-based adsorbent with the chemical formula of $\text{HTi}_{0.5}\text{Zr}_{1.5}(\text{PO}_4)_3$, derived by extracting lithium from $\text{LiTi}_{0.5}\text{Zr}_{1.5}(\text{PO}_4)_3$ and designated as H-TZP(Li). $\text{MnO}_2(\text{Li})$ and HSbO_3 showed the highest selectivity for the lithium ion among alkali metal ions, whereas IXE-300 and H-TZP(Li) had the highest selectivity for the sodium ion.

The four adsorbents examined were all isotopically ^6Li -specific; that is, the lighter isotope, ^6Li , was preferentially fractionated into them rather than aqueous solutions. The values of $^7\text{Li}/^6\text{Li}$ isotopic separation factors, S , observed between them and 0.1M lithium hydroxide solutions were 1.009 - 1.025 at 25 °C, and the decreasing order of the S values was IXE-300 > HSbO_3 > H-TZP(Li) > $\text{MnO}_2(\text{Li})$. The value of $S = 1.025$ obtained for IXE-300 is the largest ever observed for organic and inorganic adsorbents (ion exchangers) in aqueous systems at 25 °C. Even the smallest value of 1.009 obtained for $\text{MnO}_2(\text{Li})$ was several times larger than those observed for organic ion exchangers. These results suggest that the four adsorbents examined all have the potential of becoming excellent lithium isotope separators. The temperature dependence of the lithium isotope effects was normal.

A band displacement chromatography of lithium acetate with IXE-300 as packing material was attempted to examine the chromatographic behavior of the lithium isotopes. Although a leading phenomenon, which is usually unfavorable for isotope separation systems using chemical exchanges, occurred at the front boundary of the lithium adsorption band, ^6Li was found depleted in the rear part of the band and accumulation of the single-stage isotope separation effect was clearly observed.