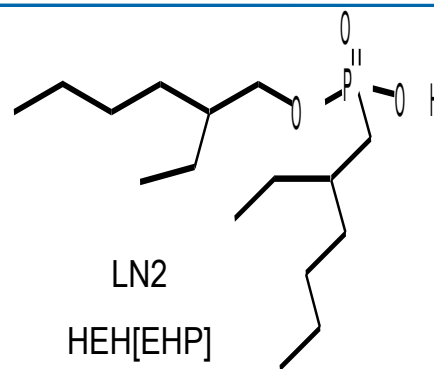


**Summary of Method** Cerium is oxidized from Ce(III) to Ce(IV) using sodium bromate and then selectively extracted from rare earth nitrate solutions using a column of LN2 resin. LN2 is an extraction chromatographic resin containing 2-ethyl-1-hexyl(2-ethyl-1-hexyl)phosphonic acid (HEH[EHP]).

Ce can be oxidized to Ce(IV) from solutions of nitric acid and rare earth nitrate using NaBrO<sub>3</sub>, while the other rare earth metal ions remain in the trivalent oxidation state. The oxidation of Ce(III) to Ce(IV) and the retention on LN2 increases with the concentration of nitrate. The oxidation will not work from chloride solutions. Berkelium (Bk) can also be oxidized to Bk(IV) and separated from other trivalent actinides and rare earths using very similar conditions.

Once oxidized, the Ce(IV) or Bk(IV) are retained on the LN2 resin from 2-3M HNO<sub>3</sub>/Rare Earth Nitrate solutions, while trivalent metal ions are not retained. After rinsing with HNO<sub>3</sub> to remove any residual trivalent metal ions, the Ce or Bk can be recovered from the LN2 by elution with 0.25-0.50M HCl or HNO<sub>3</sub> + reducing agent (H<sub>2</sub>O<sub>2</sub>, hydroxylamine or ascorbic acid). Removal of Ce from 500 mL 2M HNO<sub>3</sub> + 0.75 M Y/Yb(NO<sub>3</sub>)<sub>3</sub> was >99.9% using a 10 mL column of LN2 resin[1].

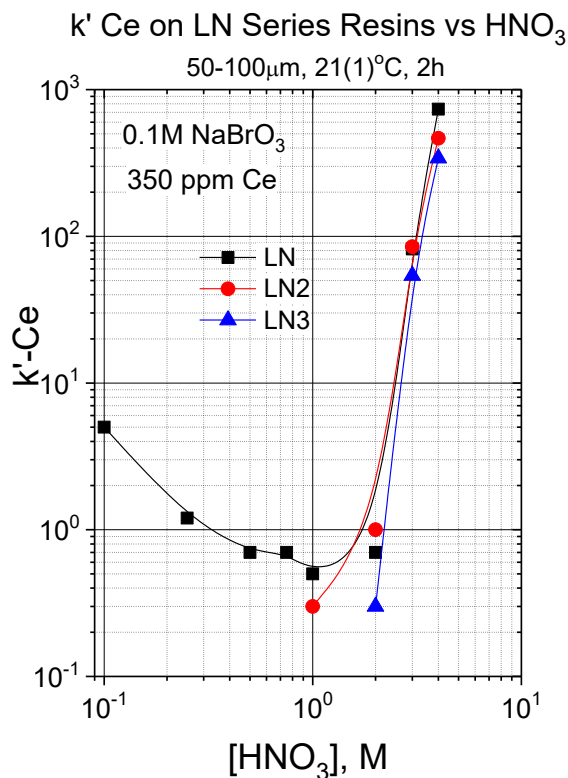


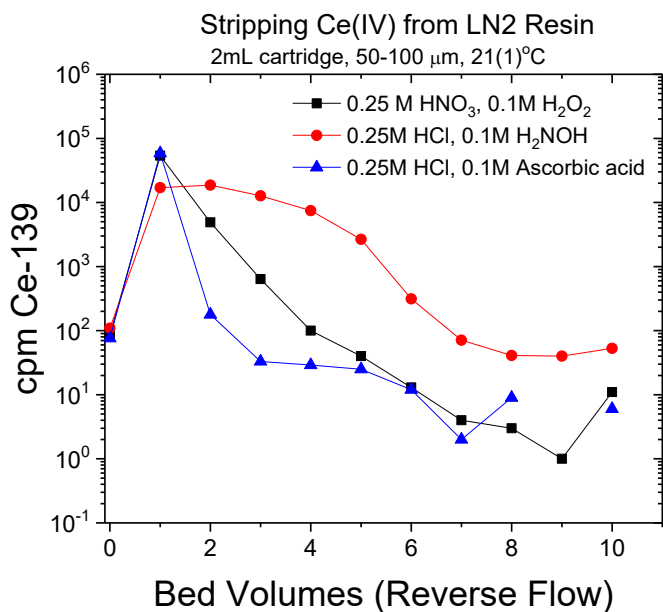
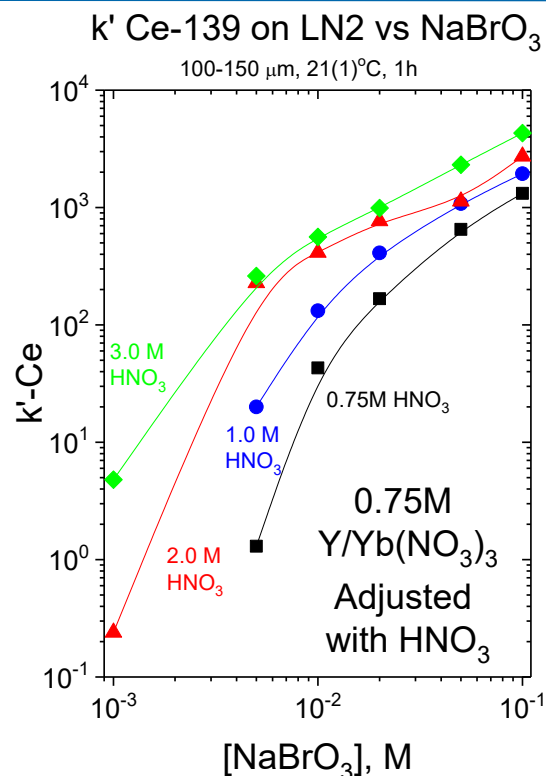
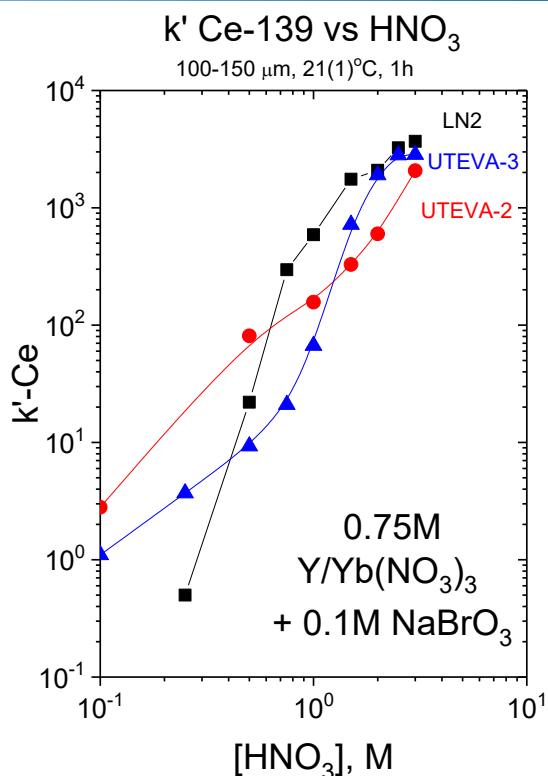
## Reagents

LN2 Bulk Resin (L2-BO1-S)  
 Nitric Acid (70%)  
 Hydrochloric Acid (37%)  
 Sodium Bromate (NaBrO<sub>3</sub>)  
 H<sub>2</sub>O<sub>2</sub> (30%), Hydroxylamine·HCl or Ascorbic Acid  
 Deionized Water

## Equipment

Empty Columns  
 2 mL snap tip (AC-141-AL)  
 2 mL cap tip (AC-100-MT-PP)  
 5 mL (AC-50E-5M)  
 20 mL (AC-20E-20M)  
 Column Reservoir  
 For 2 mL columns (AC-120-TK)  
 250 mL For 5 and 20 mL columns (AC-20X-20M)  
 Column Rack  
 15 hole for 2 mL columns (AC-103)  
 12 hole for 5 and 20 mL columns (AC-20M-RACK)  
 50 mL Centrifuge Tubes





## Ce Separation

- (1) Adjust rare earth sample to 2-3M HNO<sub>3</sub>.
- (2) Add enough NaBrO<sub>3</sub> to make 0.05-0.10M.
- (3) Precondition LN2 resin with 5 bed volumes of 2M HNO<sub>3</sub>-0.05M NaBrO<sub>3</sub>.
- (4) Load sample.
- (5) Rinse LN2 with 5-10 bed volumes of 2-3M HNO<sub>3</sub>-0.05M NaBrO<sub>3</sub>.
- (6) Rinse LN2 with 2 bed volumes of 2-3M HNO<sub>3</sub>.
- (7) Strip Ce with 5-10 bed volumes of 0.5M HCl + 0.1M reducing agent.



## References

- 1) D.R. McAlister and E.P. Horwitz, unpublished data (2013).