

Lawrence Berkeley National Laboratory

Recent Work

Title

SOME CHEMICAL PROPERTIES OF ELEMENT 97

Permalink

<https://escholarship.org/uc/item/6wt196qr>

Authors

Peterson, Joseph R.
Cunningham, Burris B.

Publication Date

1967-01-16

University of California
Ernest O. Lawrence
Radiation Laboratory

SOME CHEMICAL PROPERTIES OF ELEMENT 97

TWO-WEEK LOAN COPY

*This is a Library Circulating Copy
which may be borrowed for two weeks.
For a personal retention copy, call
Tech. Info. Division, Ext. 5545*

Berkeley, California

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UCRL-17337

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

AEC Contract No. W-7405-eng-48

SOME CHEMICAL PROPERTIES OF ELEMENT 97

Jospeh R. Peterson and Burris B. Cunningham

January 16, 1967

Meeting of the American Nuclear Society, San Diego, California, June 11-14, 1967.

SOME CHEMICAL PROPERTIES OF ELEMENT 97

Joseph R. Peterson and Burris B. Cunningham

Lawrence Radiation Laboratory
University of California
Berkeley, California

January 16, 1967

As part of a continuing program at this laboratory to investigate the chemical and physical properties of the heavy actinide elements and their compounds, a study of element 97 has been undertaken.

To date these investigations have included solution absorption studies of the tripositive berkelium ion and the preparation and crystallographic characterization of the berkelium oxides, trichloride, oxychloride, and fluorides.

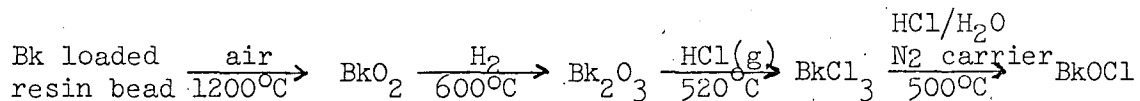
The most successful absorption experiments were carried out using a newly-developed microabsorption cell, consisting of two small (100 μ diameter) quartz rods between which was placed a small volume of Bk^{+3} (aq) solution (3-5 nanoliters containing 4 μg Bk^{249}). A suitably-modified Cary Model 14 Recording Spectrophotometer served as the measuring device, yielding spectra with 15 peaks between 320 and 700 $\text{m}\mu$. The two strongest peaks observed were at 417 and 474 $\text{m}\mu$. The observed spectral features are in excellent agreement with those seen by Gutmacher et al.¹ at the Livermore branch of the Lawrence Radiation Laboratory.

An attempt to observe the tetrapositive berkelium solution absorption spectrum by electrolytically oxidizing the Bk^{+3} (aq) solution while loaded on the cell was unsuccessful. It was concluded that the failure resulted from the bulk

solution acting as a reducing medium upon the tetrapositive berkelium ions formed locally at the anode.

About 16 μg of Bk^{249} were recovered and purified by extraction from an aqueous nitrate solution with di-(2-ethylhexyl)orthophosphoric acid, followed by stripping of the organic phase with a peroxide in nitric acid solution. The aqueous berkelium solution was then further purified by standard ion-exchange techniques. Mass analysis determined total cerium and neodymium content to be 0.27 and 0.06 atom per cent, respectively.

This purified material was absorbed on Dowex 50 (ca. 10 ppm ash) resin beads of about 200 nanogram capacity each. Employing the techniques described by Cunningham² and Green,³ the following series of reactions was performed to prepare the indicated berkelium compounds:



The fluorides were prepared from the oxides by reaction with H_2/HF mixtures and F_2 gas. Several independent samples (all containing ≥ 95 atom per cent Bk^{249}) of these compounds were characterized by use of x-ray powder techniques. BkO_2 exhibited the face-centered cubic (fluorite) structure; Bk_2O_3 , the Mn_2O_3 -type body-centered cubic structure; BkCl_3 , the UCl_3 -type hexagonal structure; BkOCl , the PbFCl -type tetragonal structure; and BkF_3 appeared to exhibit two stable modifications, the YF_3 -type orthorhombic structure and the LaF_3 -type trigonal structure, the latter one being the high temperature form.

Comparisons between the lattice parameters of these berkelium compounds and other similar actinide compounds consistently show evidence of the so-called "actinide contraction." Similar comparisons to corresponding lanthanide compounds and the behavior of the berkelium-fluorine system provide additional important evidence for the continuing rare-earth-like character of the actinide elements beyond the point of the half-filled 5f subshell.

REFERENCES

1. R. G. Gutmacher, E. K. Hulet, R. Loughheed, J. G. Conway, W. T. Carnall, D. Cohen, T. K. Keenan, and R. D. Baybarz, The Absorption Spectra of Bk^{3+} and Bk^{4+} in Solution, (submitted to J. Inorg. Nucl. Chem.).
2. B. B. Cunningham, Microchemical Journal, Symposium (1961).
3. J. L. Green, The Absorption Spectrum of Cf^{+3} and Crystallography of Californium Sesquioxide and Californium Trichloride, University of California, Lawrence Radiation Laboratory Report UCRL-16516, November 1965.

9
This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

- A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

