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THE CHEMISTRY OF BERKELIUM: A REVIEW*

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ABSTRACT

Element 97 was first produced in December 1949, by the bombardment of americium-241 with accelerated alpha particles. This new element was named berkelium (Bk) after Berkeley, California, the city of its discovery [Thompson, Ghiorso, and Seaborg, *Phys. Rev.* **77**, 838 (1950); **80**, 781 (1950)]. In the 36 years since the discovery of Bk, a substantial amount of knowledge concerning the physicochemical properties of this relatively scarce transplutonium element has been aquired. All of the Bk isotopes of mass numbers 240 and 242 through 251 are presently known, but only berkelium-249 (β^- decay, 0.125 MeV, $t_{1/2}$ = 325 days) is available in sufficient quantities for bulk chemical studies. About 0.7 gram of this isotope has been isolated at the HFIR/TRU Complex in Oak Ridge, Tennessee in the last 18 years. Over the same time period, the scale of experimental work using berkelium-249 has increased from the tracer level to bulk studies at the microgram level to solution and solid state investigations with milligram quantities.

Extended knowledge of the physicochemical behavior of berkelium is important in its own right, because Bk is the first member of the second half of the actinide series. In addition, such information should enable more accurate extrapolations to the predicted behavior of heavier elements for which experimental studies are severely limited by lack of material and/or by intense radioactivity.

The chemistry of berkelium, with emphasis on solid state and solution properties, has been reviewed. Areas where experimental data are lacking have been noted.

SUMMARY

This review has been published in extended form elsewhere [J. R. Peterson and D. E. Hobart, "The Chemistry of Berkelium," *Advances in Inorganic Chemistry and Radiochemistry* **28**, 29-72 (1984)]. The material covered includes the following topics:

Nuclear Properties, Availability, and Applications
Separation and Purification
Atomic Properties
Metallic State
Compounds
Solution Chemistry
Concluding Remarks

CONCLUSIONS

Knowledge of the stability of the various oxidation states of an element is fundamental to the understanding of its physicochemical behavior. For element 97, oxidation states 0, III, and IV are presently known. The range of oxidation states accessibile to Bk may be expanded to incude Bk(II) and/or Bk(V) by the use of highly complexing aqueous, nonaqueous-organic, or molten salt media or solid state matrices. The search for less stable oxidation states of berkelium should be continued.

Studies of berkelium metal under pressure will aid in a more precise determination of its bulk modulus. The search for the existence of a distorted face-centered cubic modification between the known fcc and alpha-uranium-type orthorhombic phases is in progress.

The preparation and characterization of new intermetallic compounds and alloys of berkelium should be pursued. At present, only a few organometallic complexes of berkelium have been prepared and studied.

A significant number of Bk(III) complexation constants have been reported. Although attempts have been made, no stability constants of Bk(IV) complexes have been reported to date.

Although a great deal of knowledge concerning the physicochemical properties of berkelium has been aquired, further work is needed to elucidate more completely both the solid state and solution chemistries of this element.

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