

Gas Phase Chromatography of HfBr₄

E. R. Sylwester, D. C. Hoffman, J. Adams, Y. H. Chung, K. E. Gregorich, M. B. Hendricks, M. R. Lane, C. Laue, D. M. Lee, C. A. McGrath, D. A. Shaughnessy, D. A. Strellis, P. A. Wilk.

The Heavy Element Volatility Instrument (HEVI)¹ was used to investigate the volatility of HfBr₄. HEVI is an On-line isothermal gas phase chromatography system which separates short lived isotopes based on their volatility. The 6.8-min ¹⁶⁶Hf, the 1.7-min ¹⁶⁵Hf, and the 2.0-min ¹⁶⁷Hf were produced at the 88-Inch Cyclotron by the reaction of ¹⁹F with a target of natEu. Reaction products were transported by a He/KBr gas jet system and continuously collected on a quartz wool plug kept at 900° C in a quartz chromatography column. HBr was added at a rate of 100 ml/min in order to form the volatile species HfBr₄, which was then swept into the isothermal section of the chromatography column, where it was separated from the other reaction products. The separated species was reattached to KBr aerosols and transported through a capillary system onto a glass wool filter placed in front of an intrinsic Ge gamma detector.

¹⁶⁵Hf was identified by gamma spectroscopy of the 180 keV gamma line. ¹⁶⁶Hf was identified by gamma spectroscopy of the 78.76 keV line, and ¹⁶⁷Hf was identified by its 315.24 keV line. Volatility was determined by measuring the yield of each isotope simultaneously as a function of the temperature of the column. All three isotopes showed exactly the same volatility behavior when their different half-lives were taken into account, as expected. The temperature at which HfBr₄ was observed to be volatile was 250° C.

A Monte Carlo simulation program² was used to calculate the adsorption enthalpy of these species based upon their volatilities. The adsorption enthalpy for HfBr₄ on a SiO₂ surface based upon the volatility data collected was calculated to be -107±5 kJ/mol.

Figure 1 shows the volatility data collected for ¹⁶⁵Hf and ¹⁶⁷Hf. The yield curves shown are the volatility curves calculated by the best fit of the data to an adsorption enthalpy value of -107±5 kJ/mol using the Monte Carlo simulation program.

Footnotes and References

1. B. Kadkhodayan, *et al.*, *Nucl. Instr. Meth.* **A317**, 254 (1992).
2. A. Türler, K. E. Gregorich, D. C. Hoffman, D. M. Lee, H. W. Gäggeler, LBL annual report #31855, Nuclear Science Division (1991).

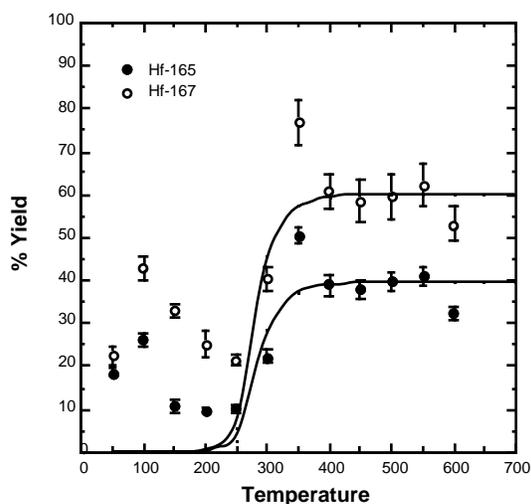


Fig. 1. Observed yields of HfBr₄ as a function of temperature. The fitted curves show the expected yield based upon the Monte Carlo calculation of an adsorption enthalpy of -107±5 kJ/mol, which is the best fit to the data.