Gas Phase Chromatography of Neptunium Bromides

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The Heavy Element Volatility Instrument (HEVI)[1] was used to investigate the volatility of neptunium bromide compounds. In the HEVI, short-lived species are separated by volatility in the gas phase. The 3.85-min ^{229}Np was produced at the 88-Inch Cyclotron via the $^{233}U(^{1}H^{1+}, 5n)^{229}Np$ reaction. Reaction products were collected by a He/KBr gas jet system and deposited continuously on a quartz wool plug in the 900 ºC section of a quartz chromatography column. The activity was halogenated with a constant flow of HBr, forming volatile bromides of neptunium, probably $NpBr_5$. This was then swept into the isothermal portion of the column, where it was separated. The separated species were reclustered with KBr aerosols and deposited on glass fiber filters. These filters were placed on Passivated Ion-Implanted Planar Silicon (PIPS) detectors to count emitted alpha particles, where ^{229}Np was identified by its 6.89 MeV alpha peak.

Figure 1 shows the relative yield of ^{229}Np activity through the HEVI. The high yield at low temperatures is mechanical in nature, and is probably related to mass transport of undecomposed aerosols. It is not related to chromatographic separation.

From the observed volatility of $NpBr_5$, a Monte Carlo simulation program[2] yielded an adsorption enthalpy of -176 ± 4 kJ/mol for $NpBr_5$ on a surface of SiO_2.

Figure 2 shows the trend in adsorption enthalpy for pentavalent bromide compounds. The values for the Group 5 elements are from Türler[3]. The expected reversal in these trends indeed occurs with Ha, as predicted by theory[4]. The potential for contamination by oxybromides indicates more work is necessary.

References

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3. A. Türler, *Radiochim. Acta* 72, (1996).
4. V. Pershina, *Chem. Rev.* 96, (1996).

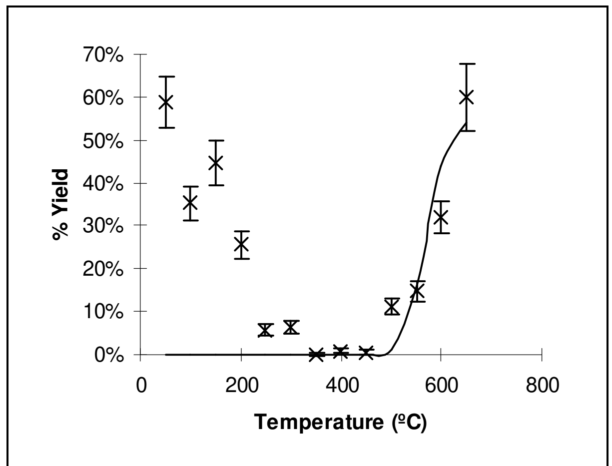

Fig. 1. Relative yields of $^{229}NpBr_5$ as a function of temperature. The solid line is the best-fit to these data from the Monte Carlo simulation program.

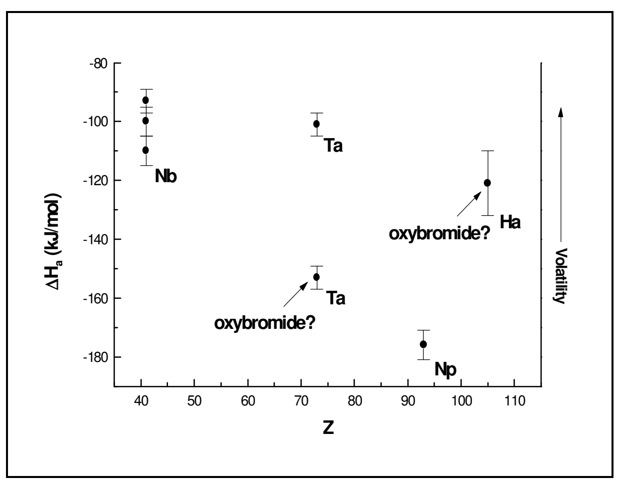

Fig. 2. Trends in adsorption enthalpy and volatility of pentavalent bromide compounds.