Gas Chromatography of Neptunium Oxybromides

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The Heavy Element Volatility Instrument (HEVI)[1] was used to further investigate the bromide chemistry of neptunium in the gas phase. HEVI is an isothermal chromatography system that separates compounds of short-lived isotopes according to their volatility. A He/KBr gas jet was used to transport recoil products from the target chamber. The reaction $^{233}U(50\ MeV\ H^+, xn)^{234-x}Np$ was used to produce the 4.0 minute ^{229}Np and the 4.6 minute ^{230}Np.

A previous experiment[2] showed that bromide compounds of neptunium were volatile at 575 •C. To show that this experiment was not contaminated by oxygen and to investigate the formation of oxyhalides in the HEVI, this experiment was repeated with oxygen added quantitatively. Results gathered in with experiments with oxygen present should differ from those gathered without, assuming the HEVI is not always contaminated with oxygen.

The recoil products were deposited on quartz wool in a 900 •C reaction oven. HBr was added at a rate of 100 mL per minute and a non-explosive mixture of O_2 and He was added at a rate of 10 mL per minute. At this temperature, volatile oxybromide compounds of neptunium formed and were transported to the cooler isothermal portion of the quartz chromatography column. Molecules that are still volatile at this lower temperature will continue to migrate down the length of the column, where they are attached to KBr aerosols and transported to a glass fiber filter. These filters are then assayed using PIPS (Passivated Ion-implanted Planar Silicon) detectors and characteristic alpha energies are measured.

At this time, the data for this experiment have not been fully analyzed. Questions remain as to the structures of the compounds formed in the reaction oven. The presence of oxygen in the HEVI has been observed to produce a notable change in volatility for neptunium bromide compounds at a given temperature. This change is most likely due to the formation of oxybromides, such as NpO_2Br. A complete analysis of the data will provide details about the compounds being formed in the HEVI and Monte Carlo simulations of the chromatographic process will provide thermodynamic information about these compounds.

Footnotes and References

1. B. Kadkhodayan et al., *Nucl. Inst. Meth.* A317, 254 (1992).

2. J. L. Adams et al., *NSD 1997 Annual Report*, N24 (1997).

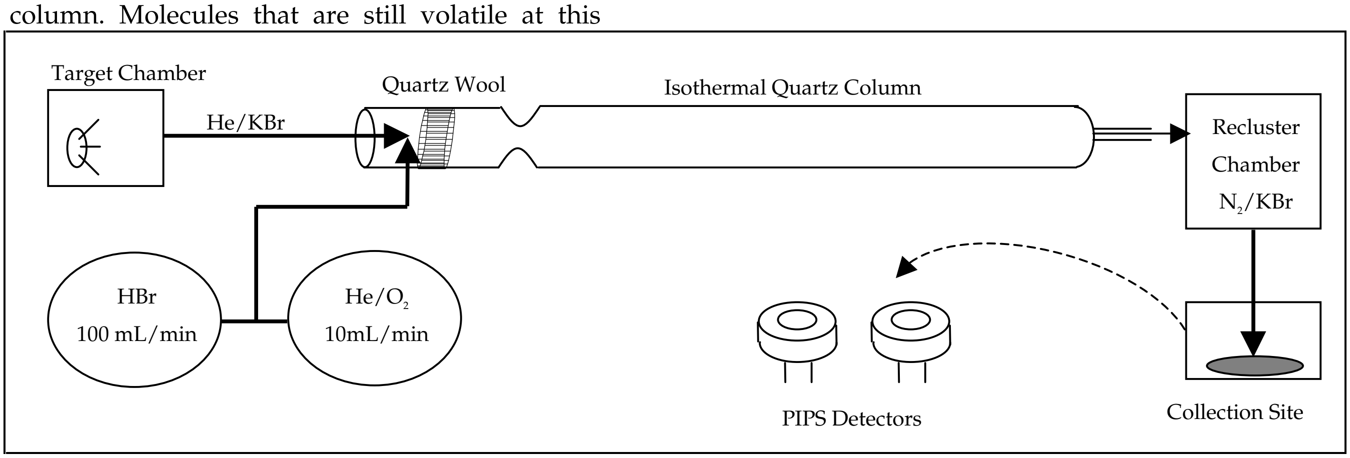

Fig. 1. The Heavy Element Volatility Instrument with HBr and He/O_2 as reactive gases.