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Gas Phase Chemistry at the BGS: Scientific Opportunities and Technical Challenges

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The Berkeley Gas-filled Separator (BGS) separates evaporation residues from transfer products as well as the intense heavy-ion beam. In our gas phase studies, the beam-free environment in the thermalization chamber was utilized and organic molecules were directly introduced as reactive species. Volatile metal complexes were formed in-situ within the Recoil Transfer Chamber (RTC) and forwarded to either a detection system or a chemistry set-up. In first studies about which we report here, complexes of the group 4 metals hafnium and zirconium with hexafluoroacetylacetone were investigated. The scientific opportunities that open up when beam-free separated isotopes are used will be outlined.

The interface between a separator and a chemistry set-up is crucial in such studies. The separator is either at vacuum or at a low pressure on the order of millibars, while the chemistry side is usually at pressures on the order of bars (unless vacuum chemical set-ups are employed). In the present version, the interface consists of a thin Mylar window of a few micrometers thickness. Long-lived isotopes of transactinides (TAN) are produced in asymmetric reactions leading to slow evaporation residues the recoil ranges of which are hardly known and can only be predicted with limited accuracy. Very thin foils need to be supported and can withstand only limited pressure differences. This puts constraints on the transport mechanisms that can be employed for forwarding the TAN to chemistry set-ups. Optimum support structures and window materials need to be studied in more detail.

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