

Towards livermorium chemistry: Atom-at-a-time gas chromatography studies with polonium

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The chemistry of the radioelement polonium has gained growing interest due to its formation in accelerator-driven systems, but it is scarcely studied owing to its pronounced radiotoxicity. As the lighter homologue of the superheavy element livermorium, whose chemical behaviour is unknown experimentally, investigations of polonium are also needed to prepare future experimental studies of livermorium. Thus, we have investigated the volatility and reactivity of atom-at-a-time quantities of polonium by applying gas-solid thermochromatography. ²⁰⁴Po was produced at the Nuclear Physics Institute of the Czech Academy of Sciences in Řeř (Czech Republic) by irradiating ²⁰⁶Pb targets with a ³He beam. Experiments were performed in helium gas or oxygen-containing gas mixtures on quartz surfaces with different degrees of reactivity, i.e., hydroxylation. On quartz glass with a low OH-concentration in helium, a volatile species with an adsorption enthalpy of 85_{-2}^{+3} kJ/mol was found and assigned to elemental polonium. On a highly hydroxylated quartz glass, an additional deposition zone of a less-volatile species was observed and attributed to a polonium species formed by chemical reaction with the surface. In oxygen-containing atmosphere and on a quartz glass with lower hydroxylation, elemental polonium and two additional species with lower volatilities, probably oxides of polonium, were observed. The chemical yield of the formed species was found to depend on the temperature and the water vapour content in the carrier gas. The results of the reported measurements will support preparations for future experiments with the superheavy element livermorium.