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Diamond Detectors in Transactinide Chemistry

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The possibilities of on-line thermochromatography experiments with transactinide elements depend on the material of the applied detectors. Si PIN-diodes or Si PIPS-detectors are only usable in a temperature interval between 90 K and 315 K limited by the electronic band gap of Si of about 1.1 eV. In recent experiments using the COLD [1] or COMPACT [2] detector setup, the upper bound of the temperature gradient was limited to 310 K for this reason. Therefore, the experimental characterization of less volatile elements with higher negative adsorption enthalpies is not feasible. Already the rather volatile mercury with a negative adsorption enthalpy on gold of 98 kJ/mol [3] - corresponding to a deposition temperature of about 430 K using the experimental condition of the COLD system - reveals the constrained range of the currently used setups.
In recent years the development of chemical vapor deposition (CVD) single crystal diamonds made a considerable progress concerning the available size, quality, and quantity. CVD single crystal diamond detectors can be heated up to temperatures higher than 500 K without any spectroscopic degradation, due to their electronic band gap of 5.5 eV [4]. In addition, they can be operated under broad daylight or strong IR radiation (e.g. near a heat source) and last but not least, diamond has one of the highest thermal conductivities known, which is important for reproducible properties of the chemical surface temperature.
We prepared, characterized, and tested different types of CVD diamond detector setups, aiming for an application in future transactinide chemistry experiments.

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