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Possibilities for studying the gas-phase chemistry of Cn and Fl with the Cryodetector setup behind the GRAND separator of the DC-280 cyclotron

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The study of Fl chemistry is important because of its controversial behaviour in gas chromatography experiments. In order to resolve this issue, one needs to conduct new experiments with higher statistics. A new gas-filled recoil separator GRAND was built at the Superheavy Element (SHE) Factory to provide physical separation of the desired ions with the highest efficiency possible for further experiments in physics and chemistry. The setup created for studying the chemistry of Nh was modernized to meet the requirements for experiments with Fl. The improved setup called Cryodetector consists of the RTC filled with an inert gas mixture to stop and thermalise all the reaction products coming from the GRAND separator through a thin film separating gas volume of the Cryodetector from the low pressure of the separator (0.7 Torr); gas transportation and purification system to transport volatile species formed in the RTC to the detector assembly with applied temperature gradient to adsorb the studied species at a temperature. Improvements included developing a new RTC based on recoil stopping range measurements, manufacturing new gold coated detectors, extending the linear temperature gradient from room temperature to −170 °C, implementing a closed gas loop, and replacing all components of the measurement system with new high-quality electronics for better resolution. The setup coupled with GRAND was tested in on-line experiments using short-lived radioisotopes 178,179Hg produced in 144Sm(40Ar,xn) reactions. Experimental results of collecting recoil atoms of Hg and No in different He and Ar gas mixtures are presented. A median transport time 0.2 s was achieved, which is shorter than 287Fl half-life and leads to a significant increase in transport efficiency. The test results demonstrated the setup readiness for gas adsorption thermochromatography experiments with 287Fl behind the GRAND separator.

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