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Towards selenides of the superheavy elements copernicium and flerovium

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Transactinide's chemical behavior is similar to their lighter homologues in the corresponding group of the periodic table. However, with increasing nuclear charges, superheavy elements (SHE) show deviations from the periodicity of chemical properties [1]. An experimentally exceptionally favourable case for comparative studies is the possibility of a simultaneous production of Cn (Z=112) and Fl (Z=114) in Ca-48 induced nuclear fusion reactions with Pu-242 / Pu-244 [2]. Since these superheavy elements are characterized by short half-lives and low production rates, their chemical behavior has to be explored on a single atomic scale. For this purpose gas chromatography is used, allowing for efficient studies of the interaction of volatile gas-phase species with stationary surfaces [1]. Sulphur was chosen as stationary chromatography material for such a comparative studies. In fact, extrapolative predictions, in which thermochemical state functions are correlated mutually, showed that both Cn and Fl may form stable sulfides, and since the stability trends of sulfides formation in group 12 and 14 were predicted to be opposite, FlS was expected to be more stable than CnS. In preparation of the chemical investigations of these superheavy elements, isothermal model experiments with Hg (copernicium homologue) and sulfur surfaces were conducted. Although the formation of HgS(s) is thermodynamically favored ($\Delta H_{ads}Hg(S) < -75$ kJ/mol), it was difficult to obtain reproducible results due to the slow interaction kinetics between the sulfur S8 rings (dominant sulfur allotrope at room temperature), and Hg.
Recent studies reported amorphous nano-selenium as an efficient mercury sorbent, due to the high affinity of Se towards Hg and the high surface-to-mass ratios of the nanoparticles [3]. Hence, extrapolative predictions for the group 12 and 14 selenide formation were done. Again, stability trends in group 12 and 14 are predicted to be opposite: the formation of FlSe is expected to be favored or at least similar to the homologue selenides, while the interaction between Cn and selenium is expected to be a weak physisorption. The chemical system Hg / Se is an ideal model system to investigate the kinetics and thermodynamics of the adsorption and reaction of a volatile noble metal with selenium surfaces. Hence, first model experiments on the interaction of elemental Hg with red amorphous selenium surfaces, obtained through supercooling of high temperature Se vapors on quartz tubes, were performed.
Here, first results from these investigations will be presented. Some conclusions will be drawn, which are important for the preparation of further chemical investigations of Cn and Fl.

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Primary author(s) : Mrs CHIERA, Nadine Mariel (Paul Scherrer Institute, University of Bern)

Co-author(s) : Prof. TÜRLER, Andreas (Paul Scherrer Institute, University of Bern); Dr EICHLER, Robert (Paul Scherrer Institute, University of Bern)

Presenter(s) : Mrs CHIERA, Nadine Mariel (Paul Scherrer Institute, University of Bern)

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