

## The In-Situ Synthesis of Volatile Oxides of Osmium and Ruthenium with CALLISTO

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The chemical properties of element 108, hassium, are not known yet. It is supposed, that it should show a chemical behaviour similar to osmium and ruthenium, because they are all members of group 8.

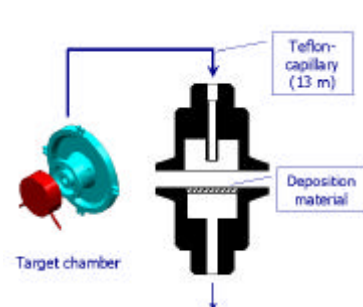
Osmium and ruthenium are able to form volatile tetroxides. This leads to the conclusion, that hassium may be able to form a stable and volatile tetroxide too. To prepare such an experiment, it is necessary to investigate the on-line production and transport of the tetroxides of ruthenium and osmium.

For that reason, a Continuously Working Arrangement For Clusterless Transport Of In-situ Produced Volatile Oxides, **CALLISTO**, was developed. The volatile oxides can be prepared directly in the target chamber by slowing down the products of the nuclear fusion reaction in a helium-oxygen mixture. Osmium and ruthenium were produced at the UNILAC through bombardment of a <sup>nat</sup>Yb-target / <sup>nat</sup>Sr-target with a <sup>12</sup>C-beam. We found, that a target chamber with a small volume leads to better yields at higher beam intensities (Fig. 1).

The yield also depends on the helium flow. We found, that a helium flow of at least 500 ml/min is necessary to transport the volatile oxide efficiently.

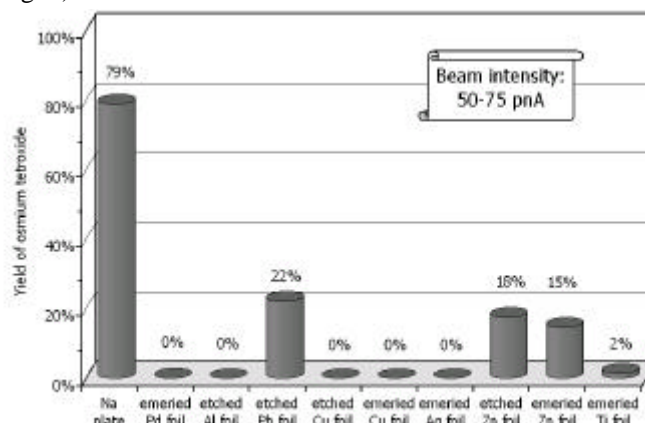
Because of the clusterless transport, only volatile by-products are able to leave the target chamber. In the nuclear fusion reaction using a <sup>12</sup>C-beam, <sup>18</sup>F and <sup>15</sup>O are formed as by-products. We investigated their removal.

The volatile oxides can be deposited directly on glass fibre filters, soaked with sodium hydroxide, which was done in the optimisation of the transport efficiency, and on metallic surfaces (Fig. 3).



**Figure 3:** Basic scheme of the deposition process

RuO<sub>4</sub> can be deposited more easily, because it is more reactive than OsO<sub>4</sub>. For the deposition of OsO<sub>4</sub>, very reactive and alkaline materials, like metallic sodium, can be used efficiently (Fig. 4).

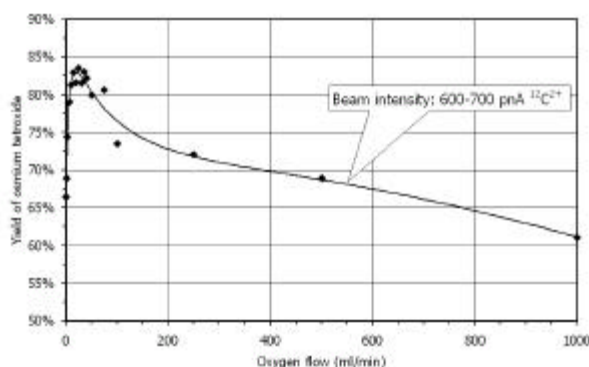


**Figure 4:** Comparison of different metallic surfaces for the deposition of gaseous, carrier-free OsO<sub>4</sub>

**Figure 1:** Comparison of different target chambers

To determine the most suitable material for this target chamber, different inserts were tested.

For maximum yield, it is necessary to determine the optimum mixture of helium and oxygen. We found a maximum at 10 ml/min O<sub>2</sub> for osmium and at 75 ml/min for ruthenium. This maximum was confirmed at different beam intensities (Fig. 2).



**Figure 2:** Dependence of the absolute yield of osmium tetroxide on the oxygen flow

In order to be able to perform isothermal gas chromatography at low temperatures, water vapour had to be removed from the transport gas. To this end, a drying unit, using molsieve, Mg(ClO<sub>4</sub>)<sub>2</sub> and Sicapent®, was implemented and the concentration of water was lowered from about 300 ppm to about 6 ppm.

It should be possible to stick the volatile oxides after the isothermal gas chromatography section to clusters, so different recluster chambers were installed. These clusters are subsequently deposited on thin foils by impaction inside the rotating multidetector apparatus, ROMA, for detection.