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Electrochemical experiments planned for TASCA

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Due to the presumably noble metal character of superheavy elements with Z ≥ 108 [1], electrochemical deposition experiments with these elements should be possible. First experiments were performed with Pb, the homolg of element 114. Short lived α-emitting Pb isotopes were produced in the reaction ^{152}Gd(^{40}Ar, xn)$^{192-x}$Pb at the UNILAC. Using the ALOHA device the recoil nuclei were transferred into the aqueous phase (0,1 M HCl, 70°C)and transported to an electrolytic cell designed for metal tape shaped electrodes. Pb was electrodeposited onto a Pd coated Ni tape electrode at a potential of –250 mV (vs. Ag/AgCl). The tape was stepped manually in 5 to 20 s intervalls in front of an array of three PIN diodes for α-spectroscopy. It could be demonstrated, that the electrochemical deposition and subsequent detection of accelerator produced short lived nuclei is feasible [2].

Common transfer products in nuclear reactions with actinide targets like Po and Bi undergo electrochemical deposition very easily, resulting in an α-background. To suppress these unwanted nuclei, electrochemistry experiments with superheavy elements have to be installed behind TASCA.

To achieve a reasonable overall yield, the investigated nuclide should have a half-lifes of more than 10 s. For an application in the field of supereavy element chemistry, the most promising candidate is ^{270}Hs ($t_{1/2}$ = 30s) which decays via α-decay to ^{266}Sg. This nuclide undergoes spontaneous fission with a very short half-life of 350 ms [3]. The detection of this α-SF correlation would be a significant indication for the the successful electrodeposition of ^{270}Hs.

To prepare an electrochemistry experiment with Hs at TASCA, the following steps are necessary:

1. Offline electrodeposition experiments with Os and Ru as homologs of Hs to investigate kinetic and thermodynamic properties of the electrochemical depositon. Carrier free Ru is accessible via neutron induced fission of ^{235}U, ^{193}Os can be produced by neutron activation of natural Os.
2. Development of an fully automated apparatus consisting of
   - the ALOHA device,
   - a pump for the electrolyte transport,
   - an electrolyte heating unit,
   - electrolytic cell for metal tape electrodes,
   - automated tape transport unit,
   - detector phalanx (consisting of 2 x 8 detectors).
3. KCl Cluster transport studies at TASCA/RTC with short-lived Os isotopes, e.g. ^{172}Os ($t_{1/2}$ = 19,2 s) and ^{173}Os ($t_{1/2}$ = 16 s).
4. Test of the fully automated apparatus with short lived, α-emitting Pb isotopes (deposition on a Ni(Pd) tape)
5. Test of the fully automated apparatus with α-emitting Os isotopes
6. Hs electrochemistry experiment

[1] B. Fricke, Structure and Bonding, 21, 89 (1975)
[2] H. Hummrich, Doctoral thesis, University of Mainz (2006)
[3] A. Türler, Vortrag Pacifichem 2005, 15.-20.12.2005, Honolulu, Hawaii, USA