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Preparations for redox studies of seaborgium with SISAK coupled to the flow electrolytic column FEC

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An important motivation for investigating chemical properties of the transactinide elements is whether the Periodic Table keeps its validity as an ordering scheme in the transactinide region, i.e. for element number 104 and onwards. Strong relativistic effects, which increase approximately as a function of Z^2 and are thus most pronounced in the heaviest elements, are expected to make the properties of transactinide elements different from their lighter homologs. Therefore, the heaviest elements provide the best “laboratory” to study the influence of relativistic effects. A close link between experiment and theory is indispensable as relativistic effects can only be “detected” by comparing experimental results with those predicted by modern quantum-chemical calculations. However, due to the short half-lives and extremely low synthesis rates of transactinide elements, the experimental challenges are huge: Experiments are performed under “one-atom-at-a-time” conditions which of course restrict available chemical methods significantly. Finding suitable experimental methods is challenging, but in addition these methods should shed light on relevant and interesting properties which can be related to theoretical calculations.

A property which can be studied both experimentally [1] and theoretically [2] is redox potentials. A Japanese-German-Norwegian collaboration has undertaken to investigate redox potentials of element 106, seaborgium, using the fast liquid-liquid extraction system SISAK [3] coupled to the newly developed flow electrolytic column (FEC) [1]. SISAK consists of a series of purpose built small centrifuges coupled to a liquid scintillation detection system. The complete system operates in a true continuous manner, i.e. it is true “on-line”, which makes it one of the fastest liquid-phase systems available for chemical investigation of transactinide elements. The system was successfully used for studies of element 104, rutherfordium [3]. The main idea is to differentiate between seaborgium in its hexavalent state and lower oxidation states (after “on-line” reduction in the FEC). By selecting suitable ligands which make e.g. hexavalent species positively charged and lower oxidation states (tetravalent or pentavalent) negatively charged (or vice versa), an anion or cation extracting reagent should in principle clearly distinguish between reduced and non-reduced seaborgium. Work has been performed at the JAEA tandem accelerator laboratory in Tokai and at the Oslo Cyclotron Laboratory, University of Oslo, to test and further develop the combined SISAK-FEC system to achieve necessary performance for redox experiments on seaborgium, and to find chemical conditions satisfying, or at least approaching, the above mentioned principle.

This presentation will give an overview of the status and achievement of the collaborative effort described above. Further details on the FEC and redox chemistry can be found in a contribution to this conference by A. Toyoshima et al. In a second contribution by M. F. Attallah et al., details about the selection and testing of suitable liquid-liquid extraction schemes are provided.

[1] A. Toyoshima et al., *Radiochim. Acta* 96, 323-326 (2008).

[2] V. Pershina and J. V. Kratz: *Inorg. Chem.* 40, 776-780 (2001)

[3] J. P. Omtvedt et al., *Eur. Phys. J. D* 45, 91-97 (2007).

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