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Electrolytic reduction studies of Mo and W towards the reduction of seaborgium

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Seaborgium (Sg), element 106, is the third transactinide element placed at the 7th row of the Periodic Table. Similar to its lighter group-6 homologs, Mo and W, Sg is expected to be redox-active in aqueous solutions. Pershina et al. [1] theoretically calculated the redox potentials of various couples of Sg on the basis of its multiple ionization-potentials [2]. They predicted that the redox couples of Sg such as Sg(VI)/Sg(V) and Sg(VI)/Sg(IV) have a more negative redox potentials than those of the corresponding Cr, Mo, and W ones in acidic solutions [1]. This is because the reduction processes of Sg are associated with its lower ionization potentials due to the large destabilization of 6d atomic orbitals [1]. Experimental determinations of redox potentials of Sg, therefore, provide tests of these theoretical predictions and yield information on the stability of the valence 6d orbital.

The best Sg isotope for chemical investigation is 265a,bSg (a and b denote the ground and isomeric state) produced in the 248Cm(22Ne, 5n)265a,bSg reaction. Because of low production rates of 265a,bSg and their short half-live of 8.5 s and 14.4 s [3], respectively, only single atoms of Sg are present during an experiment. Standard electrochemical techniques are, thus, not applicable to reduction studies of Sg. Furthermore, continuously rapid experiments are required to efficiently separate reduced and non-reduced species and to measure the alpha decay of 265a,bSg within its lifetimes. We are, therefore, developing a novel chemistry assembly consisting of a membrane degasser, a flow electrolytic column (FEC) [4], and the continuous liquid-liquid extraction apparatus SISAK coupled with a liquid scintillation counting system [5] to carry out a continuous reduction experiment of Sg. The development of suitable liquid-liquid extraction schemes are described in a separate contribution [6].

In this contribution, electrolytic reduction of Mo and W using a FEC to prepare the reduction experiment of Sg is presented. We carried out batch-wise electrolytic reduction of carrier-free 93mMo and 176,181W radiotracers using a FEC. The electrolyzed samples from a FEC were chemically analyzed by solvent extraction with TOA and HDEHP to separate and identify reduced species from the stable Mo(VI) and W(VI) ones based on their different extraction behavior. 93mMo and 176, 181W were applied as radiotracers. We also performed cyclic voltammetry and UV/Vis absorption spectrometry of macro amounts of Mo and W in acidic solutions to obtain information on redox reactions of these elements under given conditions. In this conference, the present status of the preparatory reduction experiments with Mo and W will be presented.

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