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Liquid-phase Studies of Seaborgium using the Automated Liquid-liquid Extraction system SISAK

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SISAK is an automated liquid-liquid extraction system adopted to one-atom-at-time studies of transactinide elements [1]. It is directly connected to flow-through Liquid-Scintillation (LS) detection cells for unique identification of a given transactinide using alpha-alpha correlations and Pulse-Shape Discrimination (PSD) of beta- and gamma-induced events [2]. The system works behind a physical gas-filled preseparator to significantly reduce unwanted products from the target. This method was developed and demonstrated at Lawrence Berkeley National Laboratory using the Berkeley Gas-filled Separator (BGS) [1,2] and ²⁵⁷Rf produced in a ⁵⁰Ti on ²⁰⁸Pb reaction. It was the first time such a separator was used for a transactinide chemistry experiments and was very successful. Follow-up experiments [3] where performed which firmly established the SISAK system as suitable for liquid-phase studies of transactinide elements, provided a physical preseparator like the BGS is used to eliminate unwanted products.

Recently, a collaboration between researchers at the Japan Atomic Energy Agency´ (JAEA) Advanced Science Research Centre (ASR) at Tokai and University of Oslo was formed to perform liquid-phase chemistry experiments on seaborgium, element 106. The experiments will be performed at the Nishina Centre for Accelerator Based Science, RIKEN, using the GARIS gas-filled separator. Model and development experiments have been and will continue to be performed at the Tokai Tandem-accelerator and the Oslo Cyclotron Laboratory.

The SISAK system will be set up with an electrochemical cell to enable redox experiments to deduce important and basic chemical information about seaborgium, see NRC8 contribution by A. Toyoshima et al. for further details. For this to work SISAK must be adopted to provide equally rapid transfer as the system used at LBNL (average transport time of 20 s), but with lower flow-rate (0.1-0.2 mL/s compared to 0.4-0.5 mL/s used in Berkeley). The major obstacle to achieve this is the transfer and dissolution of the metal-ions attached to KCl aerosol-particles from the gas-jet transport and into the first liquid phase: When the liquid-flow goes down the volume ratio between liquid and gas gets more and more disadvantageous, leading to significant yield loss in this stage. A new device, based on membrane separation, was constructed which in tests at OCL have shown yields above 80 % even for flow-rates down to 0.1 mL/s, something which has never been achieved with the old centrifuge degasser [4]. Due to its simplicity the new device it is also much faster than the old degasser. Work is in progress to finalize the design and implementation with the SISAK system, results which will be reported at NRC8 together with the overall plan for investigating seaborgium.

References:

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