

Separation of ^{211}Pb with ALOHA and subsequent electrochemical deposition

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To achieve a fast and (quasi)-continuous transfer of recoil atoms from the recoil chamber into the liquid phase, the ALOHA system was constructed and successfully used in chromatography experiments [1].

To prepare liquid phase experiments with element 114, the separation of its homolog Pb with ALOHA and its subsequent electrochemical deposition was investigated. A ^{219}Rn -emanating source was prepared by co-precipitation of ^{227}Ac with $\text{Fe}(\text{OH})_3$. The source was placed in a 300 ml glass chamber where the 3,96s ^{219}Rn was allowed to decay. The daughter nuclides ^{211}Pb and ^{211}Bi were attached to KCl-clusters and transferred with a He flow of 2 l/min to ALOHA and deposited by impaction on a Ta disc. After impaction, the activity was stepped to the dissolution position and transferred to the electrolytic cell by continuously cyclic pumping of the electrolyte (0.1M HCl) with a low dead-volume HPLC pump. Fig. 1 shows the experimental set-up.

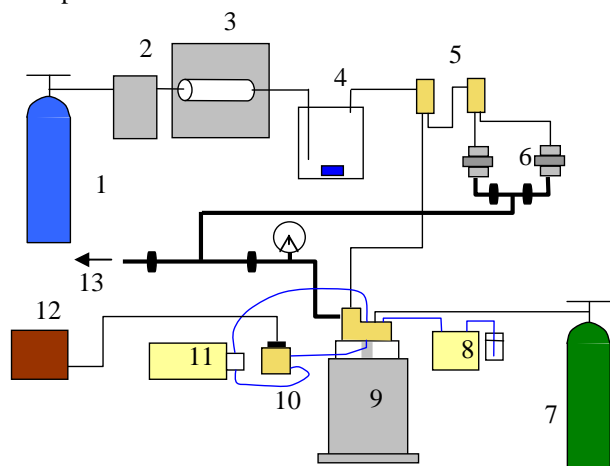


Fig.1: Experimental set-up. 1 Helium, 2 mass-flow-controller, 3 KCl cluster oven, 4 ^{227}Ac emanating source, 5 gas-jet switches, 6 direct catch and waste unit, 7 Nitrogen, 8 Acetone pump, 9 ALOHA, 10 electrodeposition cell, 11 electrolyte pump, 12 potentiostat, 13 to the ventilation system. Gas jet flow: black line, vacuum system: thick black line, liquid flow: blue line

The yield of impaction and dissolution in ALOHA (compared to a direct catch on a glassfiber filter) was measured via γ -spectrometry at different stepping times. Fig.2 shows that about 75 to 90% of the activity was successfully transferred from the gas-jet into the liquid phase using stepping times of 5s and longer. At lower stepping times, activity is lost due to the low dissolution volume.

For electrodeposition experiments with ^{211}Pb , a heatable electrolytic cell was attached to the ALOHA system. Pd was chosen as electrode material, 0.1M HCl as electrolyte. The deposition potential was -500 mV vs. Ag/AgCl.

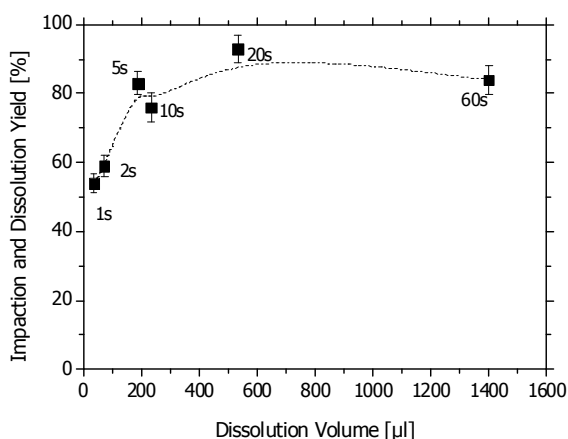


Fig.2: Impaction and dissolution yield for $^{211}\text{Pb}/^{211}\text{Bi}$ vs. dissolution volume (stepping time) with the ALOHA system, solvent 0.1M HCl

The activity was impacted for 10 min in the collection position, transferred to the dissolution position and dissolved. The deposition experiments were carried out at a temperature of ca. 75° and under vigorous stirring. At $t_{50\%}=20\text{ s}$, 50% of the activity was deposited, as can be seen in Fig.3.

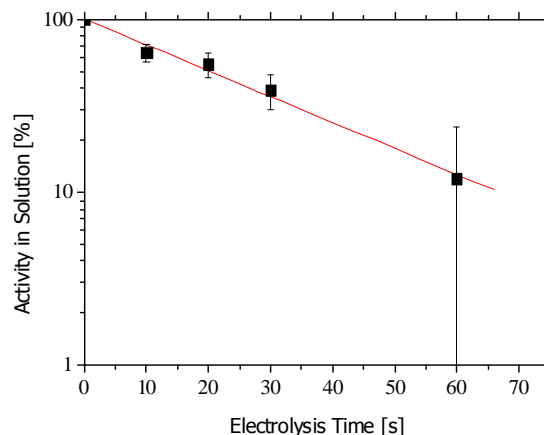


Fig 3: Electrodeposition of ^{211}Pb on Pd electrodes from 0.1M HCl at -500 mV vs. electrolysis time.

The deposited activity could also be measured via α -spectrometry after the radioactive equilibrium between ^{211}Pb and ^{211}Bi was reached. Here, a $0.1\ \mu\text{m}$ polycarbonate filter was used for the direct catch. In both cases, a FWHM of 60 keV for the 6.2 MeV line of ^{211}Bi was achieved

The presented system will be tested in a beam time at GSI with short lived Pb-isotopes in the reaction ^{40}Ar on Gd.

References

[1] A. Kronenberg et al., Annual Report, Institut für Kernchemie, Universität Mainz 2001, A4