Contribution ID: **1026** Type: **Verbal**

Online Gas Adsorption Chromatography of Tl/TlOH for Future Nh/NhOH Experiments

Tuesday, 17 May 2022 11:20 (20 minutes)

To adequatly chemically characterize superheavy elements, such as nihonium (Nh, Z=113) which has a production rate on the order of atoms per day, thorough prestudies must be completed. Gas adsorption chromatography of cyclotron-produced ^{184}Tl were conducted as preptory experiments for future Nh chemistry studies. ^{184}Tl (5 neutron evaporation channel) was produced at the U-400 cyclotron facility of the Flerov Laboratory of Nuclear Reactions (FLNR) from a 255 MeV ^{48}Ti ion beam bombarding a ^{141}Pr target (prepared on a 1.5 μm Ti-backing). Recoiling nuclear reaction products were velocity-separated in vacuum with the SHELS separator before entering the chemistry setup by passing through a 7 μm thin Mylar window. There, the isotopes are thermalized in a concial, Ar-flushed recoil transfer chamber which tapers to a 4 mm fused silica column. In the downstream direction of the column a hot tantalum foil (1000^oC), a reactive gas inlet (O_2 + H_2O), the isothermal chromatography oven (temperature range from room temperature -850^oC), and a quartz wool plug aligned with a HPGe γ-ray detector are placed. A key component of the setup was the hot tantalum foil placed after the recoil transfer chamber but before the inlet. This ensured all ^{184}Tl entering the isothermal chromatography section is in the metallic ground state. It was expected that the interaction between Tl and the hydroxyls on the fused silica surface readily promote the TlOH formation, as stated by previous studies. Unexpectedly, the influence of fused silica dehydroxylation can been seen on the external chromatogram. Shown here is the analysis of the experimental data employing isothermal gas adsoption chromatography and its impact for designing future experiments targeting an unambiguous chemical characterization of Nh.

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Session Classification: Actinoids and Transactinoids

Track Classification: Chemistry of Actinide and Trans-actinide Elements