REC SEP @ SHE CHEM
TASCA 21
June 21 - 23, 2021
18th Workshop on
Recoil Separator for Superheavy Element Chemistry

Functionalized surfaces and oxidation states of on-line produced thallium

Evgeny E. Tereshatov[1] & Charles M. Folden III[1,2]

[1] Cyclotron Institute, Texas A&M University, College Station, TX 77843, USA
[2] Department of Chemistry, Texas A&M University, College Station, TX 77843, USA

Chemical characterization of discovered and IUPAC recognized elements is one of the important tasks of superheavy element community. Nowadays, 118 known elements are named but not all of them have been chemically studied or limited number of experiments hasn't provided conclusive results. There are of course some technical limitations, for example in terms of very short half-lives ($T_{1/2} \leq 0.2$ s) for elements with $Z \geq 115$. However, elements 109 – 111 haven't been chemically studied at all and a few chemical experiments aimed at element 113 behavior still have unanswered questions. The goal of our group is to demonstrate proof-of-principle results that connect liquid phase off-line experiments with on-line gas phase chemistry. For example, usually gas phase chemical setups utilize gold coated detectors. Other coating materials also have been considered, but generally all of them lead to physisorption of desired analytes. Chemical modification or functionalization of surfaces (including a detector surface) is possible via silanization of silicon substrates [1] or self-assembled monolayer formation on gold [2]. In both cases the terminating group of a molecule attached to the surface determines the surface chemical selectivity. Imidazolium-based ionic liquids have been successfully implemented by our group for metal separation in off-line regime [3] and as a result a similar termination group has been considered for functionalization. Also, the same type of ionic liquids was used to study oxidation states of cyclotron-produced thallium and it was shown that such a chemical system is quite sensitive to reveal a non-monovalent thallium behavior [4]. Thallium in this particular case was chosen because it is the heaviest homolog of element 113 and it's believed that the cyclotron production results in the only monovalent state. Detailed results of these experiments will be discussed.

References

[1] D. Krupp and U. W. Scherer, Nuclear Inst. and Methods in Physics Research, A **897**, 120 (2018). doi:10.1016/j.nima.2018.04.038
[2] V. Zakusilova, E. E. Tereshatov, M. Boltoeva, and C. M. Folden III, In preparation.
[3] E. E. Tereshatov, M. Y. Boltoeva, V. Mazan, M. F. Volia, and C. M. Folden III, J. Phys. Chem. B **120**, 2311 (2016). doi:10.1021/acs.jpcb.5b08924.
[4] E. E. Tereshatov, M. Semelová, K. Čubová, P. Bartl, M. Němec, J. Štursa, V. Zach, C. M. Folden III, J. P. Omtvedt, and J. John, New J. Chem. **45**, 3377 (2021). doi:10.1039/d0nj05198e