

ORAL PRESENTATION - Superheavy element 114 is a volatile metal

Tuesday, 18 September 2012 10:40 (0:15)

Abstract content

The experimental determination of chemical properties of element 114 (E114) is among the hottest topics in superheavy element research. A first experiment reported E114 to be highly volatile, and to form weak physisorption bonds with Au surfaces [1]. However, the large uncertainties of the measured adsorption enthalpy covered a wide range in volatility, which prevented the experiment from yielding an unambiguous answer concerning the chemical properties of E114. A noble gas-like behavior, representing a break in the trend in group 14 in the periodic table, would be in contradiction to many recent theoretical calculations, which predict a higher volatility and inertness compared to the lighter homolog Pb, but a stronger metallic behaviour compared to Cn [2-4]. We have performed a gas phase chemical study of E114 using a combination of the TransActinide Separator and Chemistry Apparatus (TASCA) to isolate single atoms of E114 [5], and the Cryo-Online Multidetector for Physics and Chemistry of Transactinides (COMPACT) [6], a gas chromatography detector suitable for studying the interaction of single atoms with metallic Au surfaces. The setup allowed studying elements covering a broad range in volatility, from the non-volatile heavy metal Pb to the noble gas Rn, at a very low background level. In our experiment, the volatility of five elements was studied: the two superheavy elements E114 and Cn ($Z=112$), their lighter homologs Pb and Hg, and the noble gas Rn. Two element 114 decay chains, one from $^{288}114$ and one from $^{289}114$, have been detected and indicate E114 to adsorb on Au surfaces at room temperature [7]. The interaction of element 114 with Au is at least as strong as that of Cn, in contradiction with a previous experiment [1]. Our results show element 114 to be the least reactive member of group 14, but still a metal.

References

1. Eichler, R. et al., *Radiochim. Acta* 98, 133-139 (2010).
2. Pershina, V. et al., *J. Chem. Phys.* 131, 084713 (2009).
3. Pershina, V. et al., *J. Chem. Phys.* 127, 134310 (2007).
4. Zaitsevskii, A. et al., *Russ. Chem. Rev.* 78, 1173 (2009).
5. Düllmann, Ch. E. et al. *Phys. Rev. Lett.* 104, 252701 (2010).
6. Dvorak, J. et al., *Phys. Rev. Lett.* 100, 132503 (2008).
7. Yakushev, A. et al., submitted (2012).

Summary

Primary author(s) : Dr. ALEXANDER, Yakushev (GSI Helmholtzzentrum für Schwerionenforschung, Germany)

Co-author(s) : Dr. GATES, Jacklyn M (TU Munich + GSI Darmstadt); Dr. EVEN, Julia (University of Mainz, Germany); Ms. FORSBERG, Ulrika (Lund University, Sweden); Dr. GORSHKOV, Alexander (TU Munich); Dr. GRAEGER, Reimar (TU Munich); Prof. HERZBERG, Rolf-Dietmar (University of Liverpool, UK); Dr. HESSBERGER, Fritz-Peter (GSI Helmholtzzentrum für Schwerionenforschung + Helmholtz Institute Mainz); Dr. HILD, Daniel (University of Mainz); Mrs. HÜBNER, Annett (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Mr. JÄGER, Egon (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Dr. KHUYAGBAATAR, Jadambaa (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Dr. ACKERMANN, Dieter (GSI Helmholtzzentrum für Schwerionenforschung Darmstadt); Dr. KINDLER, Birgit (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt)

Darmstadt); Prof. KRATZ, Jens Volker (University of Mainz); Mr. KRIER, Jörg (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Dr. KURZ, Nikolaus (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Dr. LOMMEL, Bettina (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt); Mr. NIEWISCH, Lorenz (University of Mainz); Prof. NITSCHKE, Heino (LBNL Berkeley + UC Berkeley); Prof. OMTVEDT, Jon Petter (University of Oslo, Norway); Dr. PARR, Edward (University of Liverpool); Dr. QIN, Zhi (IMP Lanzhou); Dr. ANDERSSON, Lise-Lotte (University of Liverpool, UK); Prof. RUDOLPH, Dirk (Lund University, Sweden); Mr. RUNKE, Jörg (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany); Dr. SCHÄDEL, Matthias (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany); Mrs. SCHAUSTEN, Brigitta (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany); Mr. SCHIMPF, Erwin (GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany); Dr. SEMCHENKOV, Andrey (University of Oslo, Norway); Mrs. THÖRLE-POSPIECH, Petra (University of Mainz, Germany); Prof. TÜRLER, Andreas (TU München, Germany); Dr. UUSITALO, Juha (University of Jyväskylä, Finland); Dr. WEGRZECKI, Maciej (ITE Warsaw, Poland); Dr. BLOCK, Michael (Gesellschaft für Schwerionenforschung mbH); Dr. WIEHL, Norbert (University of Mainz, Germany); Dr. BRÜCHLE, Willy (GSI Helmholtzzentrum für Schwerionenforschung Darmstadt); Prof. DÜLLMANN, Christoph (University of Mainz + GSI Darmstadt + Helmholtz Institute Mainz, Germany); Dr. DVORAK, Jan (LBNL Berkeley + UC Berkeley, USA); Dr. EBERHARDT, Klaus (University of Mainz, Germany); Dr. ESSEL, Hans G. (GSI)

Presenter(s) : Prof. DÜLLMANN, Christoph (University of Mainz + GSI Darmstadt + Helmholtz Institute Mainz, Germany)

Session Classification : Session 3 - Chemistry of radioelements and Super Heavy Elements research

Track Classification : Chemistry of radioelements and Super Heavy Elements research