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Diamond Detector Design for Measuring $\alpha$-Decay Chains
• Introduction to Superheavy Element Chemistry

• Test Beam Time @ JAEA, Japan (2014 / 2015)

• Diamond Detectors for Measuring $\alpha$-Decay Chains

• The pureCOLD System

We are interested in **the chemical properties of transactinide elements** \((Z > 103)\) with a special focus on the volatile superheavy element metals.
Identification of single SHE atoms (e.g. E113):

- Known decay chains from nuclear physics experiments
- Measurement Technique: $\alpha$- and SF-Spectroscopy
- Time correlated emission of a $\alpha$-particle or SF-decay

Faced limitations in SHE chemistry:

- Very short-lived products ( [s] to [ms] )
- One-atom-at-a-time experiments
- Rather volatile SHE metals (homologues)

The investigation method: adsorption chromatography

Adsorption interaction with various surfaces

Relativistic effects

Nuclear fusion reaction:
$^{243}\text{Am} \ (^{48}\text{Ca}, \ x \ n) \ 291-x\text{115}$

E113 has been produced by several heavy ion induced reactions (cold and hot fusion reactions):

The IVAC Test Beam Time at JAEA (2014 / 2015)
Overview of the Experiment

**DETECTION**

**CHROMATOGRAPHY**

**TRANSFER**

**PRODUCTION**

Isothermal Vacuum Chromatography (IVAC)

- Nuclear fusion reaction and JAEA-ISOL
- Hot catcher: implantation & thermal release
- Isothermal vacuum chromatography column
- Diamond detector
The IVAC Test Setup

Incoming products

Chromatography column and oven

Hot catcher

Detection site

Ta heat shield

Thin Ta window

Mounting for resistive heating

Diamond Detector

Incoming products
Diamond Detector Assembly

Partial sphere

Cube

Corner cube

USD 272.- / %

USD 473.- / %

USD 76.- / %
Optimization by Cutting?

penetration depth [μm]

Energy [MeV]

- diamond
- silicium

150 μm plates
200 μm plates
Diamond detector assembly

9 mm
pureCOLD: $\beta-\alpha$ Pile-up Rejection

- $^{212}$Po
  - 0.299 $\mu$s
  - 8.785 MeV
- $^{212}$Bi
  - 60.6 min
  - $\beta$ 2.3 MeV
- $^{212}$Pb
  - 10.64 h
  - $\beta$ 0.3 MeV
- $^{220}$Rn
  - 55.6 s
  - 6.288 MeV
- $^{216}$Po
  - 0.15 s
  - 6.778 MeV
Involved People, Institutions & Company

Alex Vögele
Andreas Türler
Arnold Lücke
Christina Weiss
Dave Piguet
Erich Griesmayer
Ilya Usoltsev
Robert Eichler
Rugard Dressler
Silvan Streuli
Thank you for your kind attention!