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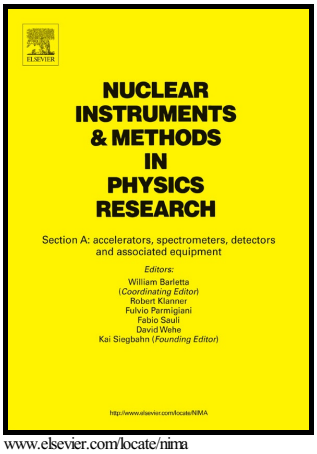

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Diamond detectors for high-temperature transactinide chemistry experiments

Patrick Steinegger[a,b,*], Rugard Dressler[b], Robert Eichler[a,b], Dave Piguet[b], Silvan Streuli[b], Andreas Türler[a,b]

[a] *Departement für Chemie und Biochemie, Universität Bern, Freiestrasse 13, CH-3012 Bern, Switzerland*

[b] *Labor für Radio- und Umweltchemie, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland*

Abstract

Here, we present the fabrication details and functional tests of diamond-based α-spectroscopic sensors, dedicated for high-temperature experiments, targeting the chemistry of transactinide elements. Direct heating studies with this sensor material, revealed a current upper temperature threshold for a safe α-spectroscopic operation of $T_{det} = 453$ K. Up to this temperature, the diamond sensor could be operated in a stable manner over long time periods of the order of days. A satisfying resolution of ≈ 50 keV FWHM was maintained throughout all conducted measurements. However, exceeding the mentioned temperature limit led to a pronounced spectroscopic degradation in the range of $453 - 473$ K, thereby preventing any further α-spectroscopic application. These findings are in full agreement with available literature data. The presented detector development generally enables the chemical investigation of more short-lived and less volatile transactinide elements and their compounds, yet unreachable with the currently employed silicon-based solid state sensors. In a second part, the design, construction, and α-spectroscopic performance of a 4-segmented diamond detector, dedicated and used for transactinide element research, is given as an application example.

Keywords: Diamond, detector, alpha-spectroscopy, high-temperature, transactinides, vacuum chromatography

*Current affiliation: Joint Institute for Nuclear Research, Flerov Laboratory of Nuclear Reactions, Dubna, Russia