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Rapid extraction of short-lived isotopes from a buffer gas cell for use in gas-phase chemistry to access elements beyond Fl

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In recent years, the chemical properties of the SuperHeavy Elements (SHE) copernicium (Cn, Z = 112) and flerovium (Fl, Z = 114) and their homolos have been extensively studied [1,2]. One main motivation for performing such experiments is to elucidate the influence of relativistic effects on chemical properties of these elements [3]. Due to low production rates and short half-lives, only single atoms are available in chemical experiments. The combination of gas-phase chromatography setups with an electromagnetic preseparator like TASCA proved to be the best experimental approach for reaching the required sensitivity for atom-at-a-time chemical studies [4]. After production via fusion-evaporation reactions and separation in, e.g., TASCA, these atoms are thermalized in the gas-filled volume and flushed to the chromatography setup with a rapidly flowing gas. This approach is currently applicable to isotopes with half-lives longer than about 0.5 seconds, and is limited by the extraction time of hundreds of milliseconds for recoils under such conditions. For elements beyond Fl, half-lives of suitable isotopes drop significantly below that level. The probably most suitable isotope of moscovium (Mc, Z = 115), ^{288}Mc, which is accessible directly via the ^{48}Ca + ^{243}Am reaction with a comparatively high cross section of about 10 pb, and has a half-life of 164^{+30}_{-21} ms [5]. To overcome this limitation, exploratory experiments were carried out with the aim to test a potentially faster system comprising the gas phase chromatography setup COMPACT [3] coupled to an existing buffer gas stopping cell operated with electric fields [5]. In this contribution, an overview of achieved performance, further optimization of the system, and the development of a new Mini-COMPACT-design will be discussed.

References

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