High precision mass measurements of intermediate-mass neutron-deficient nuclei via MRTOF-MS

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Precision mass measurements of ^{63}Cu, $^{64-66}$Zn, $^{65-67}$Ga, $^{65-67}$Ge, ^{67}As, ^{79,81}Br, ^{79}Kr, ^{80,81}Rb, and ^{79,80}Sr were performed with a multireflection time-of-flight mass spectrograph. The masses of these nuclides were determined by the single reference method using isobaric references. In order to obtain precise results, time-of-flight drift compensations were performed and a phenomenological fit function was employed. Consequently, in the case of ^{65}Ga, a mass uncertainty of 2.1 keV, corresponding to a relative precision of $\delta m/m = 3.5 \times 10^{-8}$, was obtained and the mass value is in excellent agreement with the 2016 Atomic Mass Evaluation.

KEYWORDS: Mass measurement, MRTOF, rp-process

1. Introduction

Nuclear masses of proton-rich nuclei along the $N = Z$ line are crucial in determining the reaction flow of the rapid proton-capture (rp-) process. Mass uncertainties need to be less than roughly 10 keV to significantly reduce the uncertainties of rp-process calculations [1]. Half-lives of key nuclei in the rp-process span from $\sim$ 10 – 100 ms. Multireflection time-of-flight mass spectrograph (MRTOF-MS) [2] has an advantage in the mass measurements of these short-lived nuclei since measurement time can be less than 10 ms. However there are no on-line MRTOF-MS measurements satisfying the required precision so far. In the present study, we demonstrate high-precision MRTOF-MS measurements of the intermediate-mass neutron-deficient nuclei.