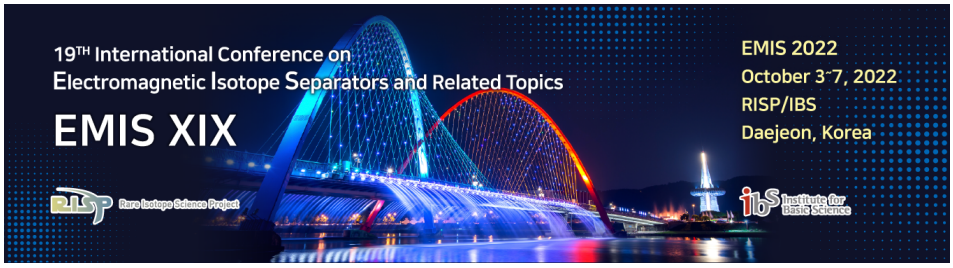

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Studies of the two-step scheme with a ^{132}Sn beam for next-generation RI-beam production method in the medium-heavy very-neutron-rich region

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The usefulness of the two-step scheme with a ^{132}Sn beam was investigated [1], which was proposed for efficient production of medium-heavy very-neutron-rich radioactive isotopes (RI) [2] as an alternative method to the direct production by means of in-flight fission of a ^{238}U beam (one-step scheme). The system of the two-step scheme consists of an isotope-separation online (ISOL) system and an in-flight fragment separator. Long-lived neutron-rich RIs (e.g., ^{132}Sn) are produced by ISOL with a thick U target and a high-intensity proton beam in the first step, and more neutron-rich RI beams (e.g., ^{128}Pd) are produced by a projectile fragmentation from the re-accelerated less-exotic RI beams in the second step.
We measured production cross sections of very neutron-rich RIs around a N = 82 region beyond ^{125}Pd, up to which the cross sections had already been measured at GSI [3], with a 278-MeV/nucleon ^{132}Sn beam produced by the BigRIPS separator [4] impinging on a 5.97-mm Be target. The yields obtained by the two-step and one-step schemes were estimated based on the measured cross sections, and we examined whether and to what extent the two-step scheme at future 1-MW beam facilities can reach further into the neutron-rich regions. This comparison suggests that the two-step scheme with the ^{132}Sn beam provides yields 40-times higher than those with the one-step scheme for the very neutron-rich N = 82 region. Moreover, by using various RI beams over the nuclear chart from ISOL, certain regions of very neutron-rich RIs around N = 50, 60, 82, and 90 regions, including the supernova r-process path, can be produced with greater yields than by the one-step approach.
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