Production cross-section measurements of neutron-rich nuclei in the northeast region of ^{132}Sn by the in-flight fission of a ^{238}U beam at 345 MeV/nucleon

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The systematic trends of production cross-sections are essential to predict not only the production rates of rare isotopes but also their purities and total rates. We measured the production cross-sections in the neutron-rich region with the atomic numbers Z = 49–57, located northeast of ^{132}Sn in the nuclear chart. The fission fragments produced via in-flight fission of a ^{238}U beam were separated and identified in flight using the BigRIPS separator. We ran four different separator settings, used with ^{132}Sn, ^{138}Te, ^{144}Xe, and ^{150}Ba as central particles. The particle identification (PID) was performed using the TOF-$B\rho$-ΔE method.[1] Figure 1 shows the PID plot summed over the four different separator settings.

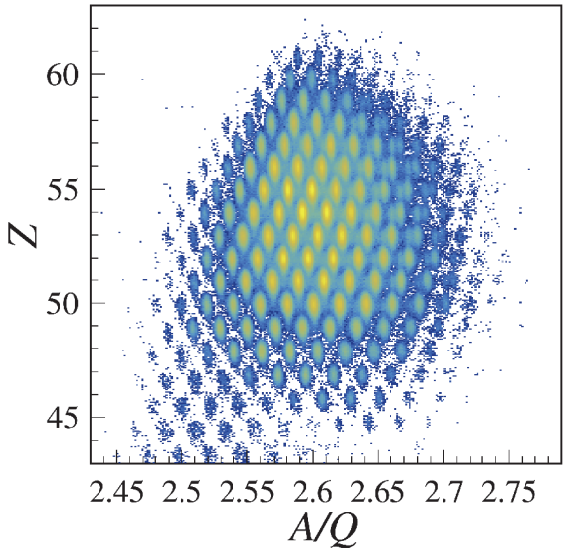

Fig. 1. PID plot for fission fragments produced in the ^{238}U+Be reaction at 345 MeV/nucleon.

Figure 2 shows the production cross-sections for each isotope as a function of mass number in this work (filled symbols) and the previous experiments[3–5] (open symbols). The measured production cross sections were derived from the measured production rates and transmission efficiencies in the BigRIPS separator, which were based on the LISE^{++} simulations.[2] The systematic uncertainty of the cross-sections is estimated to be ∼40%. The error is dominated by the uncertainties of the primary beam intensity and the transmission efficiency. Our results are in good agreement with previous ones. The blue solid lines show the cross-sections predicted using the LISE^{++} abrasion fission (AF) model.[2] The measured cross-sections have plateaued as the mass number decreases, and the AF model predictions reproduce those in this region fairly well. On the other hand, the AF model predictions underestimate the measured cross-sections in the very neutron-rich region.

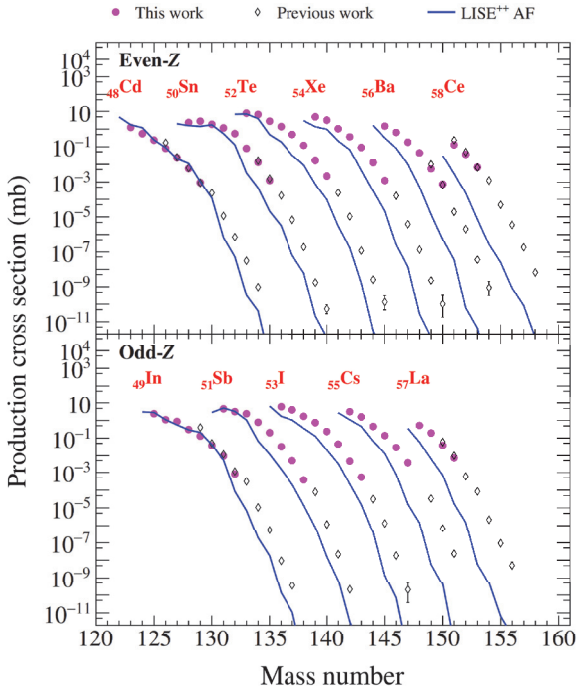

Fig. 2. Production cross-sections for each isotope from ^{238}U+Be reaction at 345 MeV/nucleon. The filled and open symbols represent the production cross-sections of this work and previous experiments,[3–5] respectively. The blue solid lines show the cross-sections predicted by the LISE^{++} AF model.[2]

Detailed analysis is currently in progress.

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