Production cross section measurements of radioactive isotopes by BigRIPS separator at RIKEN RI Beam Factory[†]

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We have measured the production rates and production cross sections for a variety of radioactive isotopes which were produced from ^{124}Xe, ^{48}Ca, and ^{238}U beams at an energy of 345 MeV/nucleon using the BigRIPS separator[1)].

Proton-rich isotopes with atomic numbers Z = 40-52 were produced by projectile fragmentation of the ^{124}Xe beam on a Be target, during which we also measured their momentum distributions. We found that the exponential tails at the low-momentum region fall off faster than those of the LISE^{++}[2)] calculation with the original parameterization. The EPAX3.01 cross-section formula[3)] agreed fairly well with the experimental cross sections. Furthermore, we have discovered four new isotopes on the proton-drip line, ^{85,86}Ru and ^{81,82}Mo. Figure 1 (a) shows a two-dimensional plot of Z versus mass-to-charge ratio (A/Q) in the ^{85}Ru setting. The four new isotopes were clearly identified on the left side of the solid lines, which indicate the limits of known isotopes. In the ^{105}Te setting, ^{103}Sb was not observed in our measurement, as shown in Fig. 1 (b). We obtained clear evidence that ^{103}Sb is particle-unbound with a half-life upper limit of 49 ns.

Neutron-rich isotopes with Z = 5-16 were produced by the projectile fragmentation of the ^{48}Ca beam on Be targets. The EPAX2.15 formula[4)] reproduces the experimental cross sections fairly well.

Neutron-rich isotopes with Z = 20-59 were produced by in-flight fission of a ^{238}U beam on Be and Pb targets. The measured production rates were compared with the LISE^{++} calculations, in which the abrasion fission (AF) model and the AF + Coulomb fission model were used for the ^{238}U+Be and ^{238}U+Pb cases, respectively. In the former case, the LISE^{++} calculations reproduced the experimental production rates well for the $Z < 50$ region but underestimated them for $Z > 50$. In the latter case, the LISE^{++} predictions reproduce them fairly well overall.

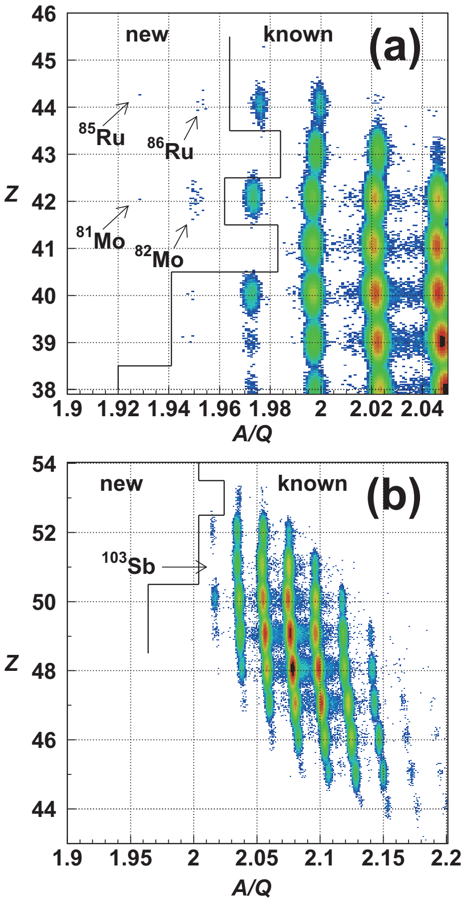

Fig. 1. (a)Enlarged two-dimensional PID plot of Z vs. A/Q for ^{85}Ru setting. ^{85,86}Ru and ^{81,82}Mo are the new isotopes. (b)PID plot for ^{105}Te setting.

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