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Nuclear transmutation of high-radiotoxic nuclide ^{90}Sr via proton- and deuteron-induced reactions in inverse kinematics

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Processing of spent fuel from nuclear power plants is a worldwide problem. The high-level radioactive waste is the product after the reprocessing of spent fuel, which includes minor actinides and fission products of radioactive waste. Especially, ^{90}Sr ($T_{1/2}$ = 28.8 years) is the highest radiotoxic nuclide in the fission products. It is highly desired to develop nuclear transmutation technology using accelerator facilities to reduce these harmful nuclides. The simplest way can be to irradiate a neutron beam on the radioactive waste. However, it is not well known that ^{90}Sr is transmuted into how much and which nuclide in this reaction. Therefore, it is essential to study, in advance, the reaction-cross-sections to each nuclide from ^{90}Sr. From this point of view, the inverse kinematics, i.e. including the ^{90}Sr beam incident on light-particle targets, is an effective method the reaction products can be identified at the forward directions.
To realize this purpose, we have planned the proton- and deuteron-induced reaction-cross-section measurements in inverse kinematics and performed the experiment using the BigRIPS separator [1] and the ZeroDegree spectrometer [1] at the RIKEN Radioactive Isotope Beam Factory. The radioactive ^{90}Sr beam with 104 MeV/u, produced and separated in the BigRIPS, incident on the C, CH_2, and CD_2 targets. The reaction products in the forward directions were transferred to the ZeroDegree and identified using the detectors at the focal plane. The reaction-cross-sections were obtained from the measured yields of each reaction channel. At this time, the contributions from carbon and beam-line materials were subtracted as a background. The obtained reaction-cross-sections were compared to the PHITS calculation [2] and the data with different energy of 185 MeV/u [3].

[1] T. Kubo, et al., Progr. Theor. Exp. Phys. 2012, 03C003 (2012).
[2] T. Sato, et al., J. Nucl. Sci. Technol. 50, 913 (2013).
[3] H. Wang, et al., Phys. Lett. B 754, 104 (2016).

Field of your work

Experiental nuclear physics

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