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Measurement of the production branching ratio following nuclear muon capture

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The energy distribution of compound states populated by nuclear muon capture can facilitate understanding the reaction mechanism. We developed a new method, called the in-beam activation method, to measure the production probability of residual nuclei by muon capture. In the method, decaying γ rays are measured simultaneously with beam irradiation by exploiting the time structure of the pulsed muon beam. Combining in-beam and ordinary offline activation methods enables the measurement of most of the β-decaying states with a wide range of half-lives from milliseconds to years. For the first application of the new method, we have measured the muon-induced activation of five isotopically enriched palladium targets of ^{104,105,106,108,110}Pd [1].

The experiment was performed at the RIKEN-RAL muon facility of the Rutherford Appleton Laboratory (RAL) in the UK [2]. The pulsed muon beam impinged on the enriched palladium targets, and γ rays from the β and isomeric decays from the reaction residues were measured using high-purity germanium detectors. The production branching ratios of the residual nuclei of muon capture for five palladium isotopes were obtained.

The experimental results were compared with a model calculation using the particle and heavy ion transport system (PHITS) code [3]. The model calculation reproduced the general trend of the obtained branching ratio rather well. In the workshop, we will present the details of the experiment and discuss the properties of compound states produced by muon capture.

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[3] S. Abe and T. Sato, J. Nucl. Sci. Tech. 54, 101 (2017).

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