

Development of New Technique to Measure Neutron-Induced Charged-Particle Emission Reactions Using Sample-Added Scintillator/試料添加シンチレータを用いた中性子誘起荷電粒子放出反応の新しい測定法の開発

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The cross sections of neutron-induced charged-particle emission reactions such as (n,p) and (n, α) for many nuclides have not been measured as well as those of the neutron capture reaction. In the present work, new measurement technique for neutron-induced charged-particle emission reactions were developed. The new method uses plastic scintillator added with sample material for measurement. The sample-added scintillator attached on a photomultiplier tube is irradiated with neutrons and charged-particles emitted from neutron-induced reactions are detected at the same time. Scintillators including sample materials were fabricated and the fabricated scintillators were tested in irradiation test experiments conducted with the Accurate Neutron Nuclear Reaction Instrument (ANNRI) of the Japan Proton Accelerator Research Complex (J-PARC). Boron nitride (BN) and lithium fluoride (LiF) were chosen as sample materials to mix with scintillator for the test experiments. The $^{10}\text{B}(n,\alpha)^7\text{Li}$ and $^6\text{Li}(n,t)^4\text{He}$ reactions occur in scintillators added with BN and LiF, respectively. The cross sections of the reactions are high and the Q-values are also high. Thus, charged particles from the reactions are easy to detect and these reactions are good for test. To identify charged particles, the pulse shape discrimination (PSD) was also employed. The pulse shape discrimination technique is based on the property of organic scintillators that the decay constant of light output changes depending on the mass and charge of charged particles. Signals from the photomultiplier tube were fed into the CAEN waveform digitizer V1720 that enables us to process signal onboard for the PSD parameter. In addition to the PSD parameter, the time-of-flight and the pulse heights of events were recorded sequentially. As a result, charged-particles were detected and identified successfully. The present contribution will report the results of the test experiments.

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