A Neutron Imaging Detector Based on the μPIC Micro-Pixel Chamber and Its Application to Time-Resolved Measurement Techniques at the J-PARC MLF

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The development of high-intensity, pulsed neutron sources, such as at the J-PARC Materials and Life Sciences Facility (MLF), has opened the door to new and powerful imaging techniques which take advantage of the precision measurement of neutron energy by time-of-flight (TOF) to greatly expand the capabilities of traditional radiography. To take advantage of these TOF-based techniques and high neutron intensities, we developed a new-type neutron imaging detector based on the micro-pixel chamber (μPIC), a type of micro-pattern gaseous detector, coupled with an all-digital, high-speed data acquisition system [1]. The detector uses ^{3}He for neutron detection (18% efficiency at 25.3 meV) and records the three-dimensional tracks of the reaction products, including energy deposition via time-over-threshold. This unique tracking method leads to a good spatial resolution of less than 120 μm (σ), as well as near perfect background rejection (γ-sensitivity less than 10^{-12}). This detector will be installed at the dedicated neutron imaging beamline (BL22) now under construction at the J-PARC/MLF [2]. We present recent results obtained with our detector at NOBORU/BL10 of the J-PARC/MLF for magnetic imaging of an amorphous iron foil using polarized neutrons. We also discuss recent and future upgrades to the detector for increased ease-of-use and improved spatial resolution and rate performance.

References

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