A novel energy resolved neutron imaging detector based on a time stamping optical camera with high spatial resolution at CSNS

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China Spallation Neutron Source(CSNS) is a pulsed neutron source because the neutrons are produced by the accelerators with a repetition rate of 25 Hz. This provides a opportunity for energy-resolved neutron imaging. At present, an energy resolved neutron imaging instrument (ERNI) is being built at CSNS. ERNI can be used to carry out Bragg edge imaging, neutron transmission imaging and neutron diffraction imaging of samples at the same time. The various advanced neutron imaging techniques can be combined with neutron diffraction techniques to obtain the microstructure, the crystal structure, residual stresses, and so on by the neutron transmission spectrum, the neutron image and the diffraction information. The wavelength resolution can reach 1‰ when the Bragg edge imaging of sample is carried out. ERNI requires a neutron imaging detector of a spatial resolution of less than 100 μm, as well as a microsecond-scale timing resolution simultaneously.

An energy resolved neutron imaging detector is constructed based on a time stamping optical camera, TPX3Cam. The time resolution is sub-microsecond scale for the detector. The detector setup is shown in Fig. 1 (a), and this detector is composed of dark chamber, scintillation screen, reflecting mirror, optical lens, image intensifier, and movable platform. The spatial resolutions are tested by using the scintillation screen including ZnS and GOS scintillation screen. It is shown in Fig. 2 that the spatial resolutions are about 100 and 50 μm for ZnS and GOS scintillation screen respectively. Thus, this detector can meet the requirement of ERNI and be applied in the pulsed neutron source. More details related to this detector can be seen in this paper " Yang, Zhou, et al. A novel energy resolved neutron imaging detector based on a time stamping optical camera for the CSNS, NIMA, 2021, 6, 1000"

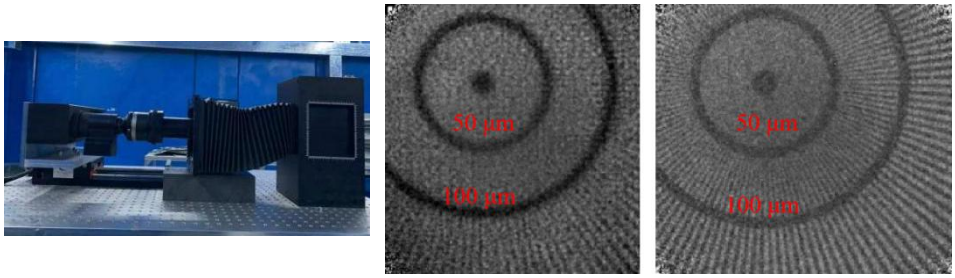

Figure 1 (a) The detector setup at CSNS (b) The imaging result using ZnS scintillation screen (c) The imaging result using GOS scintillation screen