CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval Jan. 4, 2015 承認者 Approver J. Suzuki 提出日 Date of report 2014/8/1
実験課題番号 Project No. 2013I0104 実験課題名 Title of experiment Extension of the accessible low-Q limit by using a ultra small-angle detector and small pinhole collimation 実験責任者名 Name of principal investigator Hiroki Iwase 所属 Affiliation CROSS-TOKAI	装置責任者 Name of Instrument scientist Jun-ichi Suzuki 装置名 Name of Instrument/（BL No.） TAIKAN(BL15) 利用期間 Dates of experiments 28/3/2014 – 30/3/2014

1．研究成果概要（試料の名称、組成、物理的・化学的性状を明記するとともに、実験方法、利用の結果得られた主なデータ、考察、結論、図表等を記述してください。

Outline of experimental results (experimental method and results should be reported including sample information such as composition, physical and/or chemical characteristics.

The small and wide angle neutron scattering instrument (TAIKAN) can currently cover a wide Q range from 5×10^{-3} to 20 Å^{-1}. In the near future, the accessible low-Q limit (Q_{min}) will be extended to 5×10^{-4} Å^{-1} using focusing SANS. The utilization of a high-resolution detector with spatial resolution of less than 1mm was needed to observe a SANS profile in a Q-range of the order of 10^{-4} Å^{-1} by focusing SANS. In this experiment, then, we aim to construct the high-resolution scintillation detector as an ultra-small angle detector of TAIKAN instrument and to examine the characteristics of the ultra-small angle detector.

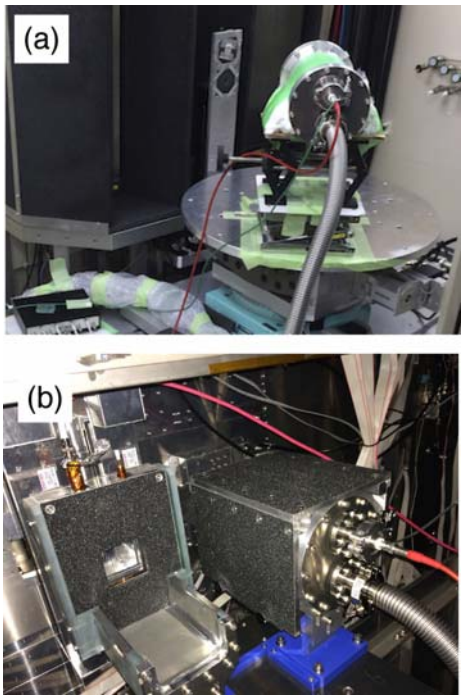

Figure 1. Experimental Setup. (a) Mounting on sample table with $2\theta = 45$ degree. (b) Mounting on the X-Z movable stage behind small-angle detector bank in scattering chamber.

Experimental Setup

The ultra-small-angle detector consists a cross-wired position-sensitive photomultiplier tube (R3239, manufactured by Hamamatsu Photonics Company Ltd, Japan) combined with a ZnS/^{6}LiF scintillator (0.2mm thick). The ZnS/^{6}LiF scintillator was newly developed by Katagiri (Ibaraki University). The scintillator thickness was selected to optimize for cold neutrons (λ-range of $\lambda \sim 5 - 8$Å). It is known that the detector efficiency of the ZnS/^{6}LiF scintillator for γ-rays is negligibly small by electrical discrimination.

The size of the effective area and its spatial resolution are Ø100 mm and 0.45 mm FWHM, respectively. The ultra-small-angle detector, packed in an aluminium vessel, was setup on the sample table [as shown in Figure 1(a)] and on X-Z movable stage behind small-angle detector bank [shown in Figure 1(b)].

Results and Discussion

In order to check the image distortion for the ultra-small-angle detector, a grid mask filter made of cadmium (4 mm pitch, spot size Ø1 mm) was set in front of the ultra-small-angle detector. And we measured the incoherent scattering from a low-density polyethylene slab (2.03 mm thick). Figure 2 shows the observed grid pattern for the ultra-small-angle detector. Within an area of W40mm × H48mm, the image distortion was negligibly small. In contrast, strong distortion was observed outside the W40mm × H48mm. Thus, the effective area for detecting the ultra-small-angle scattering was determined to be W40mm × H48mm. The effective area of same-type two-dimensional scintillation detector installed on the SANS-U spectrometer (JRR-3) was reported to be Ø74 mm. One of the reasons is mismatch of setting parameter for data acquisition (shaping times and coincidence level etc.). This parameter would depend on a scintillator. Therefore, we need to precisely determine this parameter optimized to the used ZnS/^{6}LiF scintillator installed on the ultra-small-angle detector of TAIKAN. We will employ to determine this parameter using californium-252 neutron source before starting next machine time. In addition, we found the slight spot near center position. This was observed when the detector mounted on the X-Z movable stage behind small-angle detector bank [shown in Figure 1(b)]. This would be due to electric noise. We will perform reduction of electric noise.

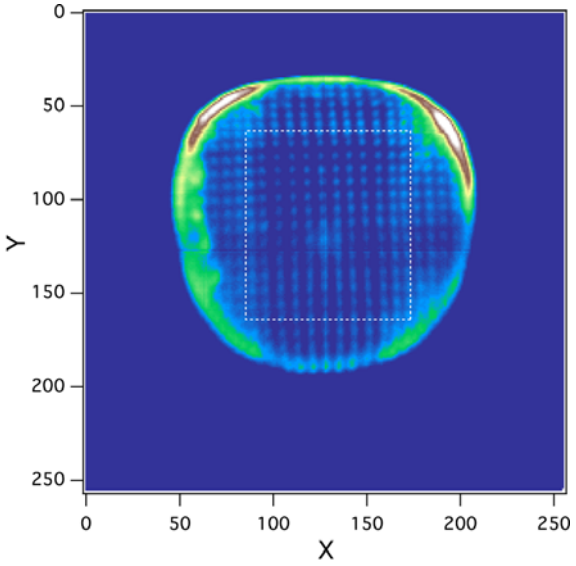

Figure 2. Two-dimensional contour map of the grid pattern detected by the HR- PSD using a grid mask filter made of cadmium. Dashed rectangle: Effective area (W40mm × H48mm) of the ultra-small-angle detector.