MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2017A0175 実験課題名 Title of experiment Small-angle neutron scattering imaging 実験責任者名 Name of principal investigator Yojiro Oba 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Takenao Shinohara 装置名 Name of Instrument/(BL No.) RADEN 実施日 Date of Experiment 2018/May/30,31

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

SiO_2 fine particles with the nominal diameter of 12, 22, 200, and 1000 nm.

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。)
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

The neutron transmission images of the SiO_2 fine particles were measured using the BL22 RADEN to extract and analyze small-angle neutron scattering contribution in neutron transmission. The particles were sealed in rectangular sample cells. A two-dimensional neutron gas electron multiplier (GEM) detector was used. The pixel size was 0.8 mm in both height and width. The distance from the neutron source to the detector was 18.8 m. Two Soller collimators were placed between the samples and the detector to absorb the scattered neutron and prevent cross-talk on the detector. Each Soller collimator was composed of a stack of gadolinium thin films deposited on silicon wafers. The effective area of the Soller collimators was 6 x 6 cm. The longest wavelength in use was about 0.84 nm.

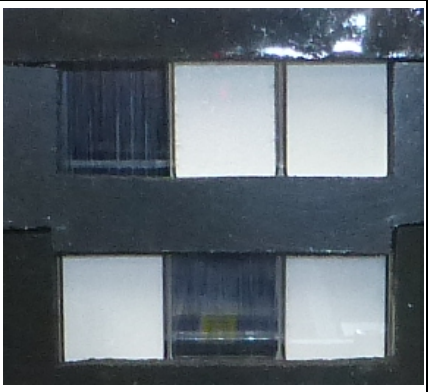

Fig. 1 SiO_2 fine particles sealed in the rectangular quartz sample cells. Black parts are B_4C rubber for neutron radiation shielding.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

The transmission of the Soller collimators is 0.85 at the wavelength of about 0.3 nm and monotonically decreases to 0.75 as the wavelength becomes longer (Fig. 2). The sharp dips in the neutron transmission spectrum are caused by Bragg diffraction of silicon used in the Soller collimators. Such sharp features can be ignored in the current experiments.

Using the Soller collimators, we successfully observed the energy-resolved neutron transmission images of the samples (Fig. 3). The wavelength dependence of the neutron attenuation coefficient shows significant difference between the samples. Since the chemical composition is same between the samples, the difference in the neutron attenuation coefficient spectra is attributed to the difference in the size [1].

Further analysis is necessary for the development of the method to evaluate and map the size of the SiO_2 fine particles.

[1] Y. Oba, S. Morooka, K. Ohishi, J. Suzuki, S. Takata, N. Sato, R. Inoue, T. Tsuchiyama, E. P. Gilbert, and M. Sugiyama, J. Appl. Cryst., 50 (2017) 334.

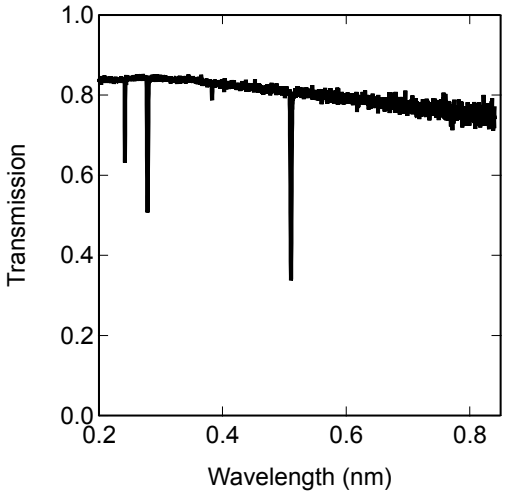

Fig. 2 Neutron transmission spectrum of Soller collimators.

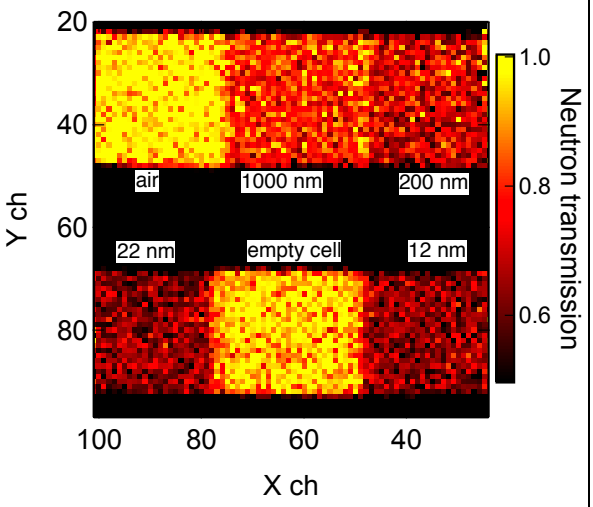

Fig. 2 Neutron transmission image of the SiO_2 fine particles with various diameters at the wavelength of 0.7 nm.