MLF Experimental Report	提出日 Date of Report March 7th, 2013
課題番号 Project No. 2012B0019 実験課題名 Title of experiment Neutron attenuation effect on strain measurement using neutron diffraction 実験責任者名 Name of principal investigator Hiroshi Suzuki 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Kazuya Aizawa, Stefanus Harjo 装置名 Name of Instrument/（BL No.） TAKUMI/ BL19 実施日 Date of Experiment Nov 9th – Nov 11th, 2012

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.

- Annealed steel plate (JIS-SM400A*) 100mm x 100mm x 50mm
- Annealed steel stick (JIS-SM400A*) 1mm x 1mm x 50mm

*JIS-SM400A: Fe, 0.2C, 0.23Si, 0.87Mn, 0.018P, 0.005S

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.

In the strain measurement using time-of-flight (TOF) neutron diffraction, the average strain in the gauge volume is weighted towards the neutron-weighted center of gravity (*ncog*), which takes into account variations in intensity within the gauge volume due to neutron attenuation and/or absence of material in the gauge volume. The difference between the *ncog* position and the geometric center of the gauge volume (*gcog*) causes an apparent peak shift, resulting in a pseudo-strain. In this study, the pseudo-strains due to neutron attenuation and surface-effects induced in the strain measurement using TOF neutron diffraction were investigated by comparing results between a high-intensity mode (HI-mode) and a high-resolution mode (HR-mode) of TAKUMI.

Radial collimators for 2 mm gauge width were installed in front of ±90° detector banks. The gauge definition slit was placed 230 mm before the diffractometer center, and the slit size was selected from 2, 8 and 14 mm widths (=*w*) with 25 mm height. Furthermore, the beam divergence slit was placed approximately 2000 mm before the diffractometer center, and the slit widths for the HR- and HI-modes were set to be 7 mm

and full-open, respectively. Figure 1 shows the variation of pseudo-strains in the plate normal direction of the annealed steel plate measured for both HR- and HI-modes. The pseudo-strain distribution for the HI-mode showed similar trend to the results obtained in the previous experiment (2012A0043). However, the pseudo-strain distributions for the HR-mode were different from those for the HI-mode. The pseudo-strains for *w*1=2mm for the HR-mode were smaller than those for the HI-mode since the beam divergence is smaller for higher resolution. It was not, however, necessarily that the pseudo-strains for the HR-mode were always smaller than those for the HI-mode. Especially, compressive pseudo-strains for the HR-mode at the depth where the gauge volume was completely immersed in the specimen exceeded the values for the HI-mode by following an increase in the size of the gauge volume. On the other hand, the pseudo-strain variations due to the surface-effect observed in the through-surface strain scanning exhibited different trend between the HI- and HR-modes although the trend to increase the tensile pseudo-strain was same. Figure 2 shows the variation of the pseudo-strains across the incident beam measured by scanning the stick specimen. The pseudo-strains were distributed linearly in the central region of the gauge area while the rapid change in the pseudo-strains was observed at the edge of that. This trend was similar between the HI- and HR-modes, but the gradient of the pseudo-strain distribution for the HR-mode was larger. This difference in the gradient would cause difference in the pseudo-strain distributions between the HI- and HR-modes shown in Fig. 1.

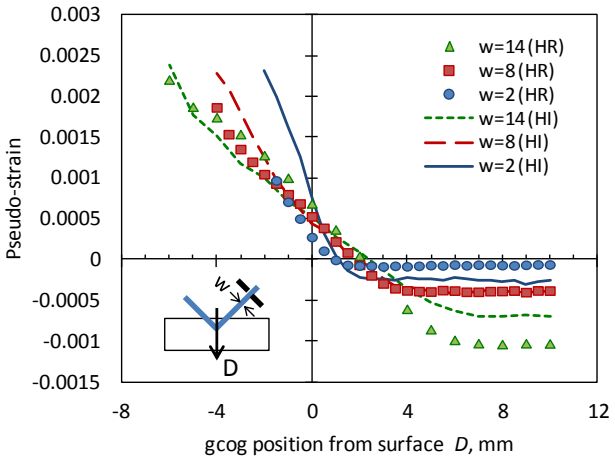

Fig. 1 Variation of pseudo-strains measured by through-surface strain scanning for the high-resolution mode (HR) and the high-intensity mode (HI).

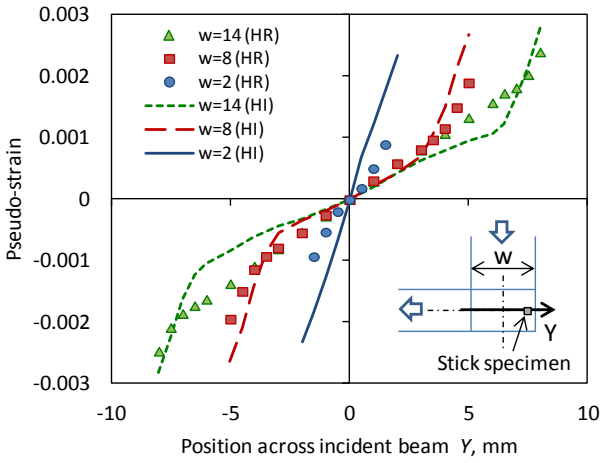

Fig. 2 Variation of pseudo-strains measured by scanning the stick specimen across the incident neutron beam for the HR-mode and the HI-mode.

As described above, the incident beam condition was important factor to determine the pseudo-strains due to the surface-effect and the neutron attenuation effect induced in the strain measurement using TOF neutron diffraction. Therefore, the incident divergence of the incident neutron beam must be carefully designed to avoid pseudo-strains in time-of-flight neutron diffractometry.