実験報告書様式（一般利用課題・成果公開利用）

（ ※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。 ）

CROSS TOKAI **Experimental Report** J-PARC	承認日Date of Approval 2015/1/4 承認者Approver Jun-ichi Suzuki 提出日Date of Report 2014/6/27
課題番号 Project No. 2014A0301 実験課題名 Title of experiment Characterization of Plastic-Working-Induced Deformation of Cu Precipitate in Steel using Small-Angle neutron Scattering 実験責任者名 Name of principal investigator Yojiro Oba 所属 Affiliation Kyoto University	装置責任者 Name of responsible person Jun-ichi Suzuki 装置名 Name of Instrument/（BL No.） TAIKAN (BL-15) 実施日 Date of Experiment 26/4/2014-29/4/2014

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.

Fe-Cu alloys with 2 aging times were measured. The one is overaging condition (50 hours), the other is peak aging condition (10 sec). The Fe-Cu alloys were cold rolled with 3 different rolling reductions (0%, 50% and 90%). The samples were cut to about 2×2 cm in width×height and about 1-2 mm in thickness.

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.

Small-angle neutron scattering (SANS) of the samples was measured at room temperature. To separate the magnetic scattering contribution and the nuclear scattering contribution, a magnetic field of 1T was applied to the samples using an electromagnet. To avoid the overlap of multiple Bragg scattering on SANS pattern, only the scattering data with wavelength longer than 0.42 nm were analyzed. MLF operated with a beam power of about 300 kW.

Figure 1 shows the SANS profiles of the Fe-Cu alloy. The profiles were obtained between q=0.09 and 3.1 nm^{-1} for the profile parallel to the magnetic field $I_{//}(q)$ and between q=0.08 and 6.1 nm^{-1} for the profile perpendicular to the magnetic field $I_{\perp}(q)$. Here, q is the momentum transfer and equal to $(4\pi/\lambda)\sin\theta$, where λ and θ are the wavelength and half the scattering angle, respectively. For $I_{\perp}(q)$, since not only the data from the small-angle detector bank but also that from the middle-angle detector bank was analyzed, the maximum of q reached a higher value than that for $I_{//}(q)$. For $I_{//}(q)$, the pole pieces of the electromagnet made a shadow on the middle-angle detector bank.

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

The SANS profiles of the Fe–Cu alloy without the cold rolling has a clear shoulder around q=0.2–1 nm^{-1} both in $I_{//}(q)$ and $I_{\perp}(q)$. Based on TEM observation, this characteristic corresponds to the scattering of nano-sized Cu precipitates. The diameter of the Cu precipitates is roughly estimated to be 3.4 nm with a broad size distribution. However, the size of the Cu precipitates in the other samples could not be evaluated because the shoulders of the SANS profiles appear in q region lower than the limit of TAIKAN. This indicates that the Cu precipitate is probably grown with the cold rolling. For further investigation, we are planning to perform the SANS experiment in low q range.

In the transmission spectra, clear Bragg-edges corresponding to {110}, {200}, {211} diffraction of bcc Fe are observed. We also found the significant change in the position of the {110} Bragg-edge with change in the cold rolling condition. This shows that the crystal texture of the Fe-Cu alloy is varied with cold rolling. For detail characterization of the Bragg-edge transmission spectra, we will carry out a curve fitting analysis based on the RITS procedure [1].

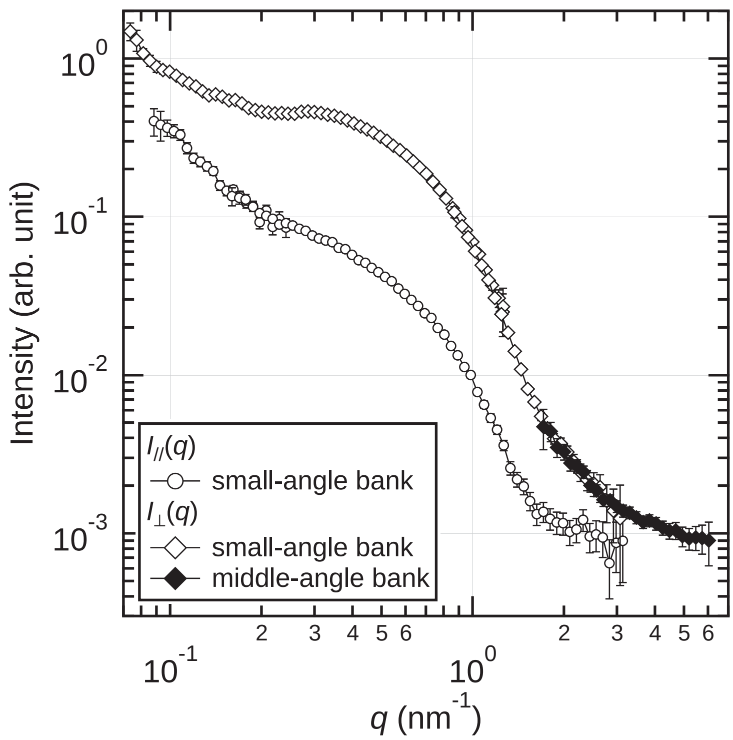

Fig. 1 SANS profiles of Fe–Cu alloy. Open circle is $I_{//}(q)$ obtained from the small-angle detector bank. Open and solid squares are $I_{\perp}(q)$ obtained from the small-angle and middle-angle detector bank, respectively.

[1] H. Sato, T. Kamiyama, and Y. Kiyanagi, Mater. Trans. 52 (2011) 1294.