MLF Experimental Report	提出日 Date of Report June 10, 2016
課題番号 Project No.2016A0127 実験課題名 Title of experiment In situ evaluation of dislocation density/structure and texture during thermo-mechanically controlled processing for steels 実験責任者名 Name of principal investigator Yo TOMOTA 所属 Affiliation: National Institute for Materials Science	装置責任者 Name of responsible person K. Aizawa and S. Harjo 装置名 Name of Instrument/（BL No.） TAKUMI (BL19) 実施日 Date of Experiment June. 16-18, 2016 (3 days) Nov. 19-21, 2016 (3 days)

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-2Mn-0.2C (mass%) alloy, Solid
- Fe-25Ni-0. 4C (mass %) alloy, Solid
- SUS310 Solid
- Fe-30Mn-6Si (mass %) alloy, Solid

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.

Three kinds of measurements were performed at BL19 of MLF J-PARC. The obtained results are still under analyses and discussion in order to make presentation and then submission as full papers.

(1) **Dynamic ferrite transformation** behavior at elevated temperatures with tensile deformation using Fe-2Mn-0.2C alloy. The cylindrical tensile specimens with 6 mm in diameter and 10 mm in gauge length were prepared. The specimens were heated up to 1000℃, held there for 10 min, then cooled down to 720, 680, or 640℃ and deformed in tension with an initial strain rate of 5 x 10^{-5}/s. During the heating and tensile deformation, neutron diffraction profiles were obtained by the two detector banks set at 90 degrees with respect to the incident beam, so that the axial and transverse diffraction profiles were simultaneously collected. The flow stresses obtained at the three temperatures were shown in Fig. 1. As seen, the flow stress becomes smaller with increasing of deformation temperature. The dynamic ferrite transformation was confirmed to occur from the changes in diffraction profiles. As an example, the changes in 111 austenite and 110 ferrite peak was depicted in Fig. 2. Then, by the Rietveld refinement using the Z-code, the ferrite volume fraction was computed as shown in Fig. 3. The change in texture, FWHM, etc. are now under investigation

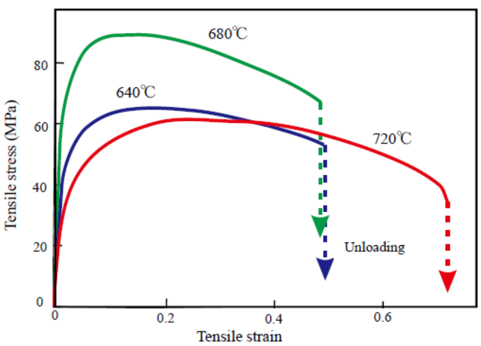

Fig. 1 Flow curves obtained at three temperatures after annealing at 1000℃.

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

in order to compare the present results with the compression deformation performed previously at ISIS.

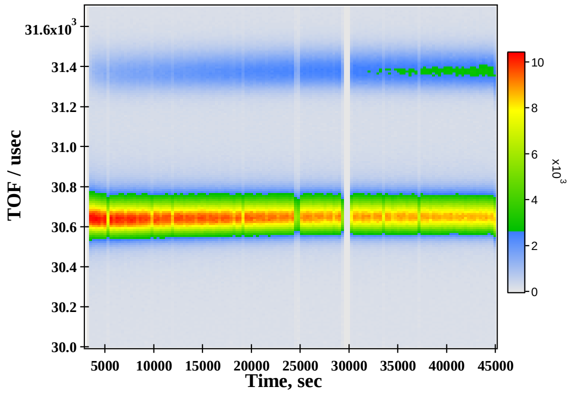

Fig. 2 Change in diffraction peaks of 111 austenite and 110 ferrite during tensile deformation at 680 ℃ showing dynamic ferrite transformation.

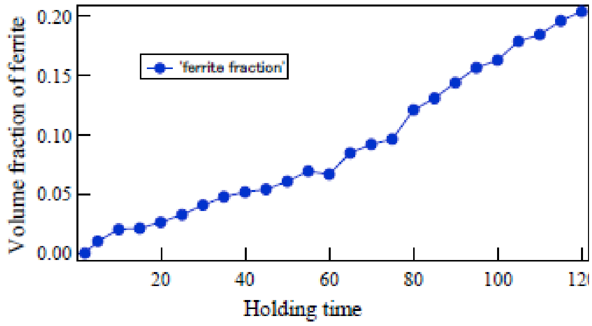

Fig. 3 Ferrite volume fraction as function of holding time at 720℃ showing the occurrence of dynamic transformation. The details on texture, grain size etc. were now under investigation.

(2) Work hardening and recovery with annealing

Tensile specimens of 2Mn-0.2C ferritic steel, 25Ni-0. 4C austenitic steel and SUS310 austenite stainless steel listed in the above specimen column (same shape and dimension with (1)) were firstly deformed in tension in a step by step manner with unloading, and then annealed without removing from the tensile jig. That is, change in diffraction profile at the identical position of a specimen was monitored. The Diffraction profiles obtained at the unloaded condition and those during holding the same temperature were analyzed using the CMWP method. The obtained results will be presented at the ISIJ spring meeting (May, 2017). The main conclusions include,

(1) Changes in dislocation density, character and arrangement could be monitored for tensile deformation followed by annealing.

(2) The dislocation density examined so far was found always higher in the transverse direction compared with that in the axial direction, both in ferritic and austenitic steels. The model to explain this difference will be proposed taking the intergranular stress and arrangement into consideration.

(3) Using the individual contrast factor for the CMWP fitting, the different dislocation densities in <hkl> grains family with respect to the tensile direction.

(4) The difference in dislocation density described at the above (3) decreases with annealing. The detailed discussion is now under investigation.

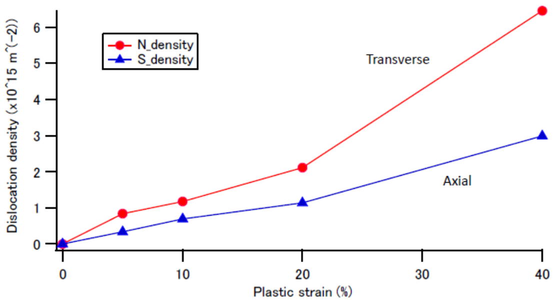

Fig. 4 Dislocation densities determined by the CMWP method for the transverse and axial diffraction profiles as a function of given plastic strain.

The cyclic tension-compression experiments at RT were additionally performed for 30Mn-6Si steel at night not to use the furnace and to obtain preliminary information for the measurements in the next Feb., 2017.