MLF Experimental Report	提出日 Date of Report July 23, 2010
課題番号 Project No. 2009B0027 実験課題名 Title of experiment Study on preferred orientation analysis with the comparison of the diffraction and transmission measurements 実験責任者名 Name of principal investigator Takashi Kamiyama 所属 Affiliation Graduate School of Engineering, Hokkaido University	装置責任者 Name of responsible person Toru Ishigaki 装置名 Name of Instrument/（BL No.） BL20 iMATERIA 実施日 Date of Experiment May 25-26, 2010

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.

1. Welded α-Fe (ferrite), called the non-textured specimen in this report.
   Low-carbon steel (Fe-0.15wt%C)
   Solid polycrystalline metal
2. Rolled α-Fe (ferrite), called the soft-textured specimen in this report.
   Low-carbon steel (Fe-0.15wt%C)
   Solid polycrystalline metal
3. Textured α-Fe (ferrite), called the hard-textured specimen in this report.
   Low-carbon steel (Fe-0.15wt%C)
   Solid polycrystalline metal

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.

2.1. Aim

We have been developing Bragg edge transmission imaging techniques at a pulsed neutron source for crystallographic visualization of crystal structure, crystalline phase, crystallographic texture, microstructure and strain. In particular, the bulk information of texture and microstructure is very important for development of high-performance structural and functional materials in terms of the strength, the formability and the electromagnetic property. For this reason, we developed the Bragg edge transmission imaging method with the Rietveld-type refinement analysis technique, based on an original computer program “RITS”. So far, the neutron imaging based on the RITS code has succesfully visualized the spatial distributions of the degree of crystallographic anisotropy caused by preferred orientation of textures, the preferred orientation axis that is parallel to a certain direction of a specimen, and the crystallite size where the extinction effect of diffracted neutrons occurs. However, neutron diffraction studies for verification of this new neutron imaging technique

have not been performed yet. Hence, we measured the time-of-flight neutron diffraction data of some textured specimens that have been already measured by the Bragg edge transmission imaging. Then, we compared each other the results given by both the transmission imaging and the diffraction.

2.2. Experimental

We carried out neutron diffraction experiments at BL20 "iMATERIA" at MLF in J-PARC. The measured specimens were the three-kind polycrystalline α-Fe; a non-textured metal that was welded, a soft-textured metal that was rolled, and a hard-textured metal that was re-crystallized. We measured a non-rotated specimen (a textured specimen) and a rotated specimen (a pseudo non-textured specimen in the Debye-Scherrer geometry) with respect to each metal. Thus, we compared the six-kind diffraction data.

2.3. Results and discussion

Fig. 1 shows the neutron diffraction results. The consistent points between the transmission imaging and the diffraction are summarized that:

(1) The Bragg peaks of {111} equivalent group and also {211} equivalent group (that are the preferred orientation axis along "the normal direction" of α-Fe) of the soft-texture are larger than ones of the non-texture. Furthermore, ones of the hard-texture are additionally larger than ones of the soft-texture.

(2) Only {110} Bragg peak of the soft-texture is smaller than one of the non-texture. This is due to the extinction effect of larger crystallites of the soft-textured metal.

Furthermore, the interesting results are that:

(1) The peaks of the non-texture that has smaller crystallites according to the Bragg edge transmission imaging with the extinction analysis are broader than ones of the soft-texture that has larger crystallites according to the Bragg edge transmission imaging with the extinction analysis. According to the Scherrer's equation, the peak broadening indicates that the crystallite size becomes small. Namely, the broadening of the diffraction peak is clearly consistent with the extinction of the Bragg edge transmission.

(2) The peak intensities of only the hard-texture are changed by a sample rotating that makes a pseudo non-textured specimen.

2.4. Conclusion and future works

A part of the validity of the Bragg edge transmission imaging was confirmed by neutron diffraction studies. In near future, we will try to compare the Rietveld refinement results of transmission imaging (RITS developed by Hokkaido University) and diffraction (Z-Rietveld developed by J-PARC).

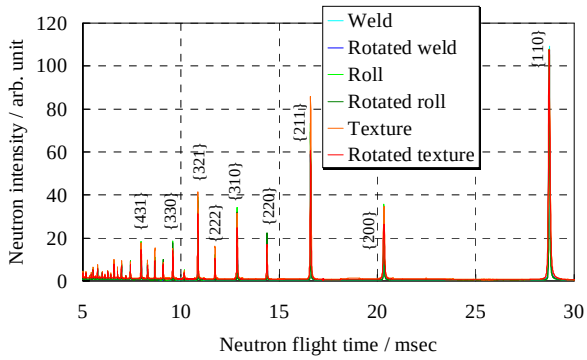

Fig. 1: Neutron time-of-flight diffraction data of some textured α-Fe metals.