実験報告書様式（元素戦略）

（ ※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。）

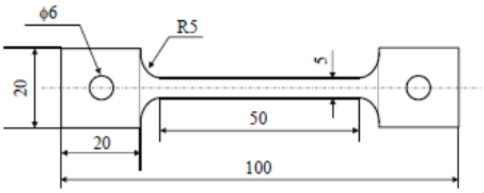
CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2013.09.30 承認者 Approver ステファヌス・ハルヨ 提出日 Date of Report 2013.09.30
課題番号 Project No. 2013S0002 実験課題名 Title of experiment In-situ neutron diffraction of ultrafine grained pure Ti foe estimation of activated slip systems during tensile deformation 実験責任者名 Name of principal investigator Nobuhiro Tsuji 所属 Affiliation Kyoto University	装置責任者 Name of Instrument scientist Stefanus Harjo 装置名 Name of Instrument/(BL No.) BL 19 (TAKUMI) 実施日 Date of Experiment 2013/05/10-2013/05/11

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.

Sample: Pure titanium (Ti)

Specimen size: Shape of a tensile specimen is shown below. Thickness was 1mm.



(mm)

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.

<u>Experimental methods:</u>

Pure Ti sheets were deformed severely by accumulate roll bonding (ARB) process. The ARB-processed sheets were annealed at various temperatures. Then, the pure Ti sheets having various mean grain size were obtained. The tensile specimens shown in section 1 were cut from the sheets having various mean grain size (mean grain size are 1.1µm, 7.6µm and 17µm).

The tensile test was carried out in the TAKUMI. In situ neutron diffraction measurements during the tensile test were conducted using the TAKUMI time-of-flight (TOF) diffractmeter for engineering material research at MLF/J-PARC. Tensile strain was measured by strain gauge attached at a gauge part of the tensile specimen. For comparison, the starting material which was not ARB-processed was also investigated.

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

Experimental results:

Figures 1 show neutron diffraction profile before deformation in the specimens ARB-processed and subsequently annealed for the tensile direction. Fig.1 (a), (b), (c) and (d) are corresponding to mean grain size of 1.1μm, 7.6μm, 17μm and the starting material, respectively. Horizontal axis and vertical axis are TOF and intensity of diffracted neutron. It is found that the specimens ARB-processed and subsequent annealing have strong texture because intensity ratio of diffraction peaks in the specimens ARB-processed and subsequent are different from that in the starting material.

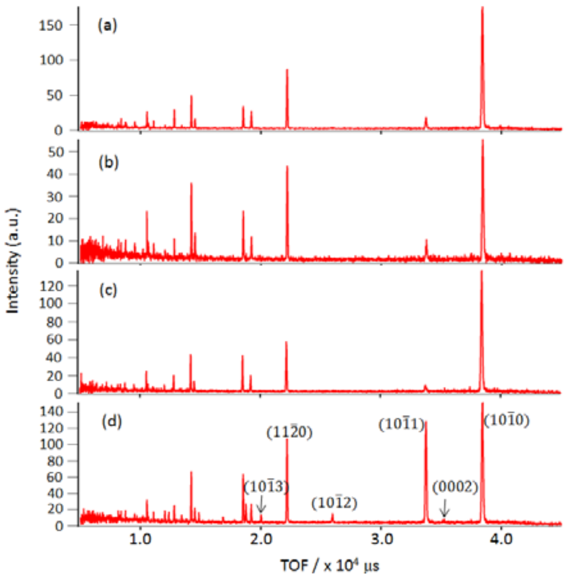


Fig. 1 Neutron diffraction profile before deformation in the specimens ARB-processed and subsequently annealed for the tensile direction. (a) 1.1μm, (b)7.6μm, (c)17μm and (d) starting material.

Figure 2 shows change in the integrated intensity for $(10\bar{1}1)$, $(10\bar{1}0)$ and $(11\bar{2}0)$ as a function of the tensile strain. In the figure, blue, red and green plots correspond to $(10\bar{1}1)$, $(10\bar{1}0)$ and $(11\bar{2}0)$, respectively. Square, triangle and circle indicate results of the 17μm specimen, 7.6μm specimen and starting material, respectively. In the present experiment, the specimen had holes for fixing pin at grip parts (shown in section 1) and stress was concentrated at the hole during tensile test. In the specimens ARB-processed and subsequently annealed, therefore, the grip parts deformed and fractured before the gauge part deformed enough. In case of the 1.1μm specimen, strain of the gauge part was less than 1%. Thus, the result of the 1.1μm specimen is not shown in Fig.2. In case of the 17μm specimen and 7.6μm specimen, strain of the gauge part was less than 8%. From Fig.2, it seems that the tendency of change in the integrated intensity of all specimens is similar.

The aim of this study is to clarify effects of grain size on crystal rotation and slip system activation during plastic deformation. In the present experiments, the tensile strain of the specimens ARB-processed and subsequently annealed was not large enough to discuss it. In the future, attachments for fixing tensile specimen without fixing by pin will be prepared in order to obtain large tensile strain in a gauge part.

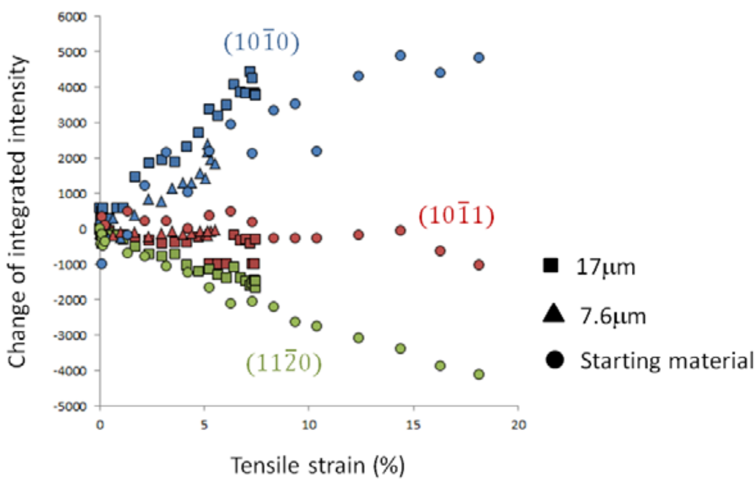


Fig. 2 Change in the integrated intensity for $(10\bar{1}1)$, $(10\bar{1}0)$ and $(11\bar{2}0)$ as a function of the tensile strain.