MLF Experimental Report

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1．研究成果概要（試料の名称、組成、物理的・化学的性状を明記するとともに、実験方法、利用の結果得られた主なデータ、考察、結論、図表等を記述してください。

Outline of experimental results (experimental method and results should be reported including sample information such as composition, physical and/or chemical characteristics.

The in situ and time-resolved diffraction measurement is significant for understanding deformation and transformation during mechanical, thermal and other process. In this project use, we developed a time-resolved measurement system which records external conditions using the universal signal readout module (TrigNET)[1] and upgraded the data analysis software for the purpose of making that measurement more flexibly and efficiently.

Figure 1 shows a schematic view of this experiment. A load frame and specimen, Inconel 617, were arranged 45 degree to the incident neutron beam to collect diffraction intensities in the directions of parallel and vertical to the load by +90 degree bank and -90 degree bank, respectively. The axial and the transversal lattice strains can be obtained from the diffraction patterns measured by these two banks simultaneously. An applied load signal from the load cell was recorded by TrigNET as time-tagged event signals same as a neutron detection and a time signals. The software extracts diffraction data according to not only the time signal but also the applied load signal.

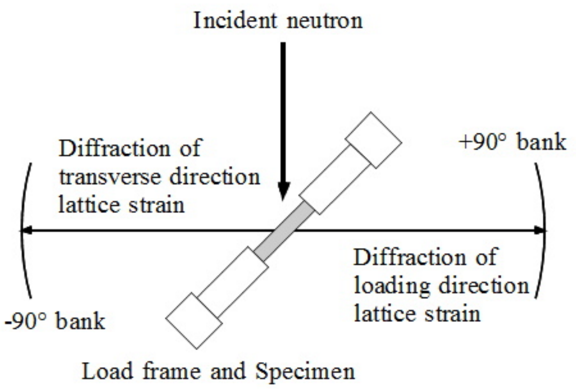

Figure 1. Schematic view of experiment of in situ neutron diffraction using load frame.[2]

Two types of diffraction measurements during tensile loading tests were performed to demonstrate effectivity of this system and software. Firstly, a step-by-step increase of applied load during diffraction measurement

１．研究成果概要（つづき） Outline of experimental results (continued).

was carried out to confirm whether or not they worked as intended. Diffraction patterns that were sliced using applied load signals were well matced with those sliced using time which corresponds to the load signals. This result shows that upgraded software works well same as a usual method.

Secondly, a cyclic loading-unloading test during diffraction measurement was carried out. Figure 2(a) shows a part of applied loads recorded by TrigNET during this test. Diffraction profiles which were reduced every 500 N step windows from 500 N to 3000 N and integrated during these cycles are shown in Figure 2(b). It can be seen that peak positions shift to higher TOF or lattice spacing. It seems that we successfully reduced data in the case of this cyclic experiment since lattice strain continuously is increased with increasing of load. This method is much useful for *in situ* measurement on a rapid cycle process, i.e., a stroboscopic measurement, for instance, a fatigue test.

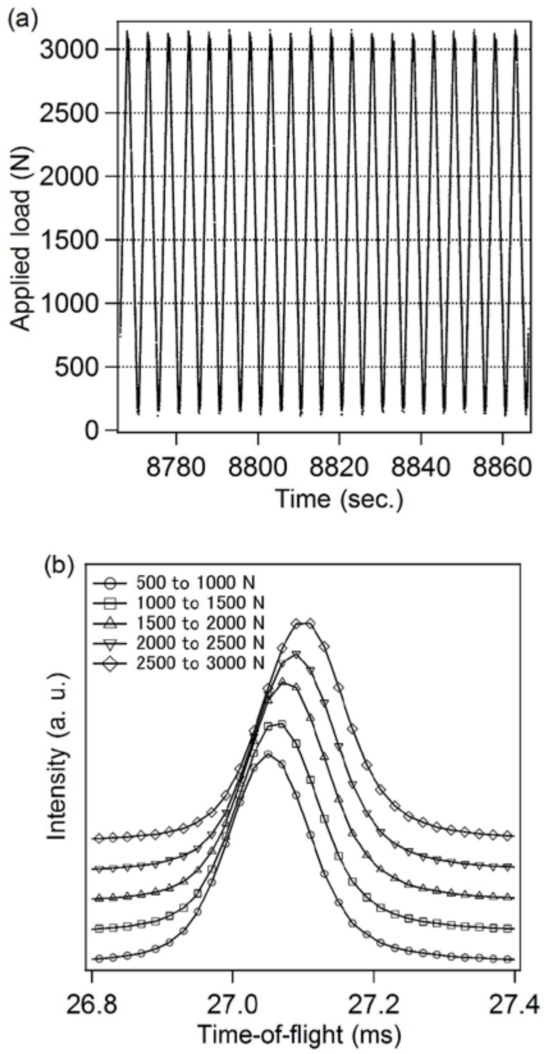

Figure 2. (a) A part of tensile load during cyclic loading-unloading test, (b) 200 reflections of the loading direction of Inconel 617.[2]

From these experiments, we revealed performance and issues of this system. Utilization of this new system potentially provides better precision, accuracy and efficient measurement methods. And an advantage of this system is that vairous experiments using external conditions can be handle in the same manner as this experiments because their singals are unified by TrigNET. One of the most important issue was data reduction in the case of using composite data slicing conditions. Another important issue was necessity of data reduction function for intensity normalization using incident beam intensity sliced in the same way.

References

[1] T. Seya, S. Muto and S. Satoh, MLF Annual Report (2010) pp. 102-103.

[2] Takayoshi Ito, Stefanus Harjo, Yasuhiro Inamura, Takeshi Nakatani, Takuro Kawasaki, Jun Abe and Kazuya Aizawa, Materials Science Forum Vols. 783-786 (2014) pp 2071-2074

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