
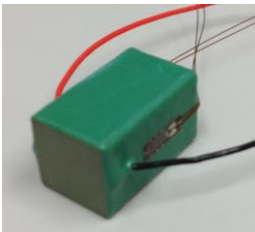


実験報告書様式(一般利用課題・成果公開利用)

(※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。)

 MLF Experimental Report	提出日 Date of Report 2014/10/10
課題番号 Project No. 2014A0162 実験課題名 Title of experiment Time-resolved strain analyses of the piezoelectric actuator under cyclic electric fields 実験責任者名 Name of principal investigator Takuro Kawasaki 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Kazuya Aizawa 装置名 Name of Instrument/(BL No.) TAKUMI (BL19) 実施日 Date of Experiment 2014/6/7 – 6/9

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 : $\text{PbNi}_{1/3}\text{Nb}_{2/3}\text{O}_3\text{-PbTiO}_3$ (PNN-PT) based piezoelectric actuator Size : 10 mm x 10 mm x 20 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.
<p><u>Experimental method</u></p> <ul style="list-style-type: none"> • Beam size was restricted as 2 mm width and 8 mm height. • 2 mm radial collimators were used. • High-resolution mode with the resolution $\Delta d/d$ of 0.17% was used. • Static and cyclic electric fields were applied to the sample using a function generator and an amplifier. • The fields were applied in the direction of 45° to the incident neutron beam. • Amplitude of the fields was 0 V – 130 V. • Frequencies of the fields were 0 Hz (static), 0.05 Hz, 0.5 Hz and 5 Hz. • Applied electric fields were recorded as event data using a TrigNET module. • Macroscopic strain of the sample was recorded using a strain gauge and a data logger.

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

Result

- Time-resolved data reduction was performed using the software developed based on the software Manyo-Lib, Utsusemi and EMAKI. Although peak shift and intensity variation which show lattice strain and domain rotation caused by the electric field was successfully observed, some improvements of the software are needed to perform data reduction in complex conditions.
- Fig. 1 and Fig. 2 show 111 reflection and 200 and 002 reflections measured in the north detector (transversal direction). Peak position of 111 reflection shifts to higher TOF direction according to an amount of the field. Intensities of 200 and 002 reflections become smaller and higher, respectively, according to the field. These are representing lattice strain caused by the piezoelectric effect and the non-180° domain rotation of PNN-PT in the actuator.
- The lattice constant a and c obtained from diffraction patterns measured in the north detector increased and decreased, respectively, according to the fields as shown in Fig. 3.
- The quantitative evaluation of lattice strain and domain rotation will be performed after the improvement of the data reduction software.

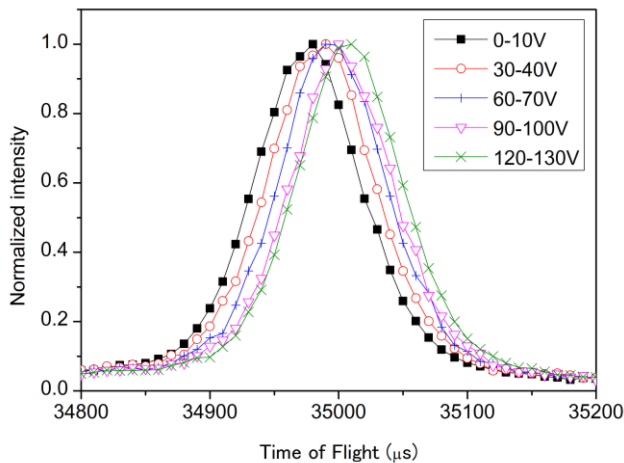


Fig. 1 111 reflection in various fields.

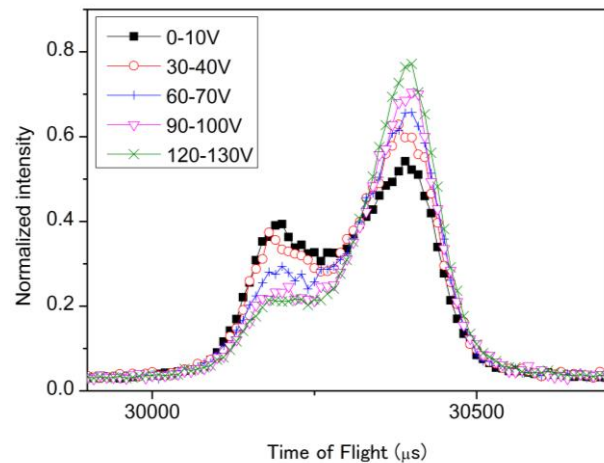


Fig. 2 200 and 002 reflections in various fields.

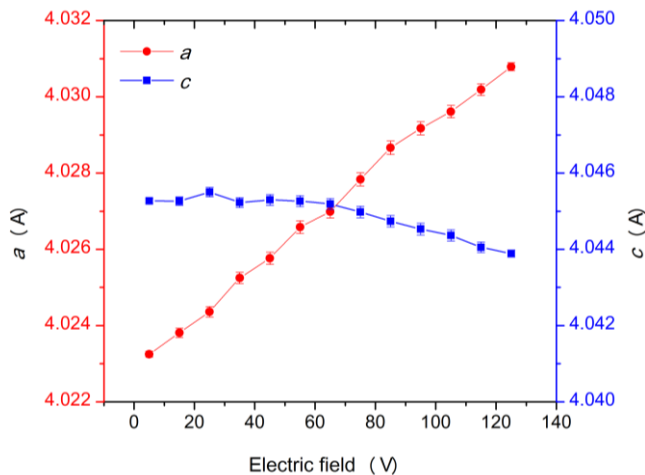


Fig. 3 Electric field dependence of lattice constants a and c .