MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2010A0001 実験課題名 Title of experiment Crystal and Magnetic Structures in (1-*x*)BiFeO3-*x*BaTiO3 with Relaxor-like Behavior 実験責任者名 Name of principal investigator Minoru Soda 所属 Affiliation Graduate School of Engineering Science, Division of Materials Physics, Kimura Lab., Osaka University	装置責任者 Name of responsible person Toru Ishigaki 装置名 Name of Instrument/（BL No.） BL No.20 (iMATERIA) 実施日 Date of Experiment 2010/11/12～2010/11/13

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.

We measured (1-*x*)BiFeO$_3$-*x*BaTiO$_3$ (BFO-BTO) with *x*=0.1, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45 and 0.5. They were sintered in three different temperatures, (820℃, 1000℃, just below the melting point) and are named T820 series, T1000 series and SH series, respectively. Outlook of the samples are shown in the pictures below. The powder diffraction experiments were performed after they were crushed into grains smaller than 1mm.

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.

The experiments were performed on above-referenced 24 samples. The grained samples were set in vanadium folders and labeled. Neutron time-of-flight powder diffraction data were collected at room temperature on BL-20(iMATERIA) at MLF in J-PARC. Data sets cover the d-spacing range of 0.094 to 4.00 angstroms in the backscattering detectors. Each measurement was continued until the total neutron count reaches about 1.6 billion.

First, we carried out structure refinements on nuclear scatterings using Z-Rietveld. **Figs.1(a), (b)** show the *x*-dependences of the lattice parameters a$_R$ and α, respectively.
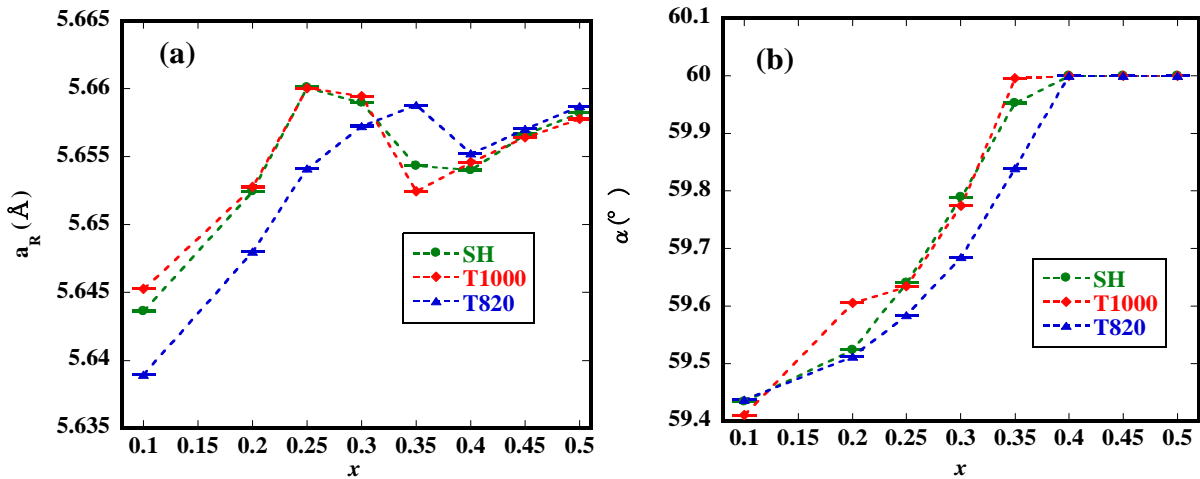
Fig.1: (a) Lattice parameter a_R(Å) v.s. x , (b) α(°) v.s. x

The overall feature of the refined parameters shown in Fig.1 were qualitatively reproduces the previously reported values.[1] When we see the result carefully, one can find subtle differences among T820, T1000 and SH series samples. These differences may be the cause of the remarkable differences in dielectric and magnetic properties among these samples.

BFO-BTO shows relaxor-like dielectric behavior only in the vicinity of x=0.33[1]. In addition, Soda pointed out that the antiferromagnetic order is suppressed with the development of relaxor behavior in the single crystal (x=0.33) using the neutron scattering method.[2] This time we carried out an analysis of magnetic reflections, comparing the intensity of magnetic reflections among the samples with different compositions. **Fig.2** shows the magnitude of the ordered magnetic moment of Fe atoms calculated from the intensity of magnetic reflection (1/2, 1/2, 1/2) normalized by (200) nuclear Bragg peak.
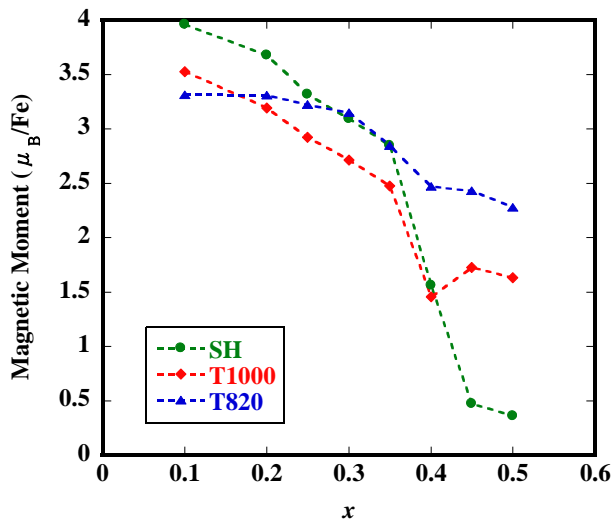

From Fig.2, we can see a remarkable decrease of the magnetic moment at the composition around 0.4 in T1000 and SH series compared with T820 series.

Fig.2: Magnetic Moment of Fe atoms

[1] M. M. Kumar, A. Srinivas, S. V. Suryanarayana, J. Appl. Phys. **87**, 855 (2000)

[2] M. Soda, M. Matsuura, Y. Wakabayashi, and K. Hirota, submitted.