CORRELATION BETWEEN REMANENT POLARIZATION AND CRYSTAL ORIENTATION IN $Pb(Zr_{1-x}Ti_x)O_3$ FILMS

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Introduction

Owing to the many potential in applications in nonvolatile memory devices, ferroelectric films of $Pb(Zr_{1-x}Ti_x)O_3$ (PZT) have been studied intensively in recent years. In order to investigate the correlation between the ferroelectric and structural properties, we studied the correlation between remanent polarization and crystal orientation for PZT films on Pt/Ti bottom electrode prepared using a sol-gel technique by X-ray diffraction.

Experimental and Results

The X-ray diffraction was carried out at BL-17A with the wave length of λ = 1.38 Å.

The tetragonal distortions of the (111), (100)/(001) and randomly oriented crystals for PZT films on Pt/Ti were measured as shown in Fig. 1. The PZT(100)/(001) profile of the (111) oriented crystals observed at χ = 55° have double peaks, PZT(100) and PZT(001). However the tetragonal distortion is not observed in the PZT(100)/(001) profiles of (100)/(001) oriented crystals at χ = 0° and randomly oriented crystals at χ = 20°. The result represents the only (111) oriented crystals will have polarization and work as memory.

In order to investigate the correlation between the remanent polarization and the ratios of (111) oriented crystals, we prepared four PZT films with same tetragonal distortion but differential ratios of the (111) oriented crystals. The values of the remanent polarization (*Pr*) of the films were 30.5, 33.3, 34.4 and 39.4 μC/cm^2, respectively.

The remanent polarization is plotted as a function of the ratios of (111) oriented crystals (R) in Fig. 2. In the figure, the solid line shows the result of fitting using the equation *Pr* = AR, where A is constant. The result indicates the remanent polarization linearly depends on the ratios of (111) oriented crystals. With increasing the ratio of the (111) oriented crystals, we will be able to obtain the nonvolatile memory with large polarization.

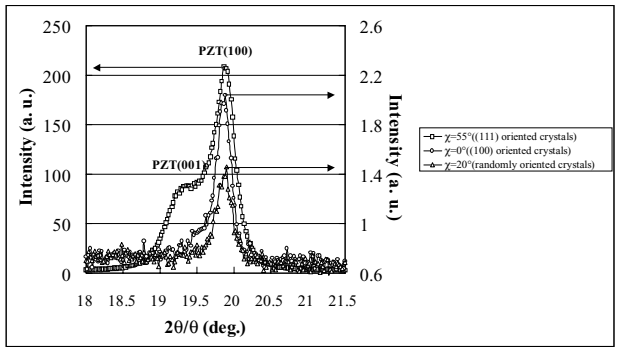

Fig. 1. The X-ray profiles observed at χ=0°, 20° and 55° around tetragonal PZT(100)/(001) peaks.

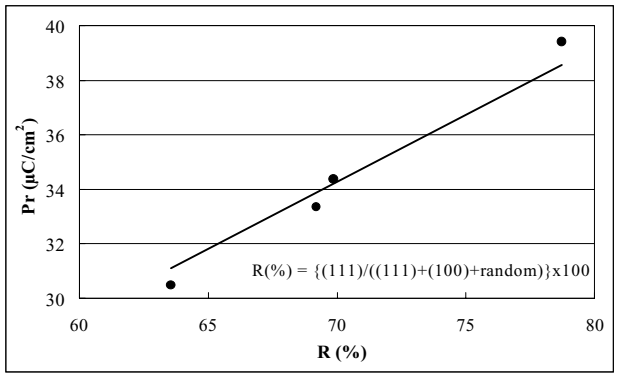

Fig. 2. The relation between the ratios of the (111) oriented crystals (R) and the remanent polarization.

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