sol-gel법을 이용한 $Pb(Zr_{0.52},Ti_{0.48})O_3$ 박막의 하부 Pt 전극과 상부 PtO_x 전극에 따른 피로현상

Fatigue in sol-gel derived $Pb(Zr_{0.52},Ti_{0.48})O_3$ thin films having Pt bottom and PtO_x top electrodes.

임지은, 조금석, 정시화, 황철성, 김승현*
서울대학교 재료공학부
*INOSTEK Inc.

Ferroelectric fatigue of top-PtO_x/Pb(Zr,Ti)O_3/bottom-Pt capacitors were systematically investigated as a function of oxygen content in the sputtered top electrode and applied voltage. It was found that there was a specific concentration of oxygen in the top electrode which produced the best fatigue endurance. The fatigue was generally became serious with increasing applied voltage for all cases. However, for these high-quality PZT samples (remanant polarization (P_r) > 30 $\mu C/cm^2$ at 5V) the fatigue endurance was very dependent on the oxygen content in the top electrode and almost irrespective of whether the cycling voltage was lower or higher than the P_r saturation voltage.

250-nm-thick PZT thin films were prepared on 111-textured Pt/Ti/SiO_2/Si wafers by a modified sol-gel technique. To vary the ferroelctric properties of the films, top Pt sputtering process was modified by adding oxygen to the sputtering gas. The sputtering gases were 0%, 2%, 5% and 10% oxygen contained Ar. Since the incorporated oxygen in the top Pt layer was easily decomposed and desorbed during post-annealing, most of the samples were not post-annealed except some samples at 650℃ in air for 30 min for comparison. Before the fatigue test, polarization - voltage (P-V) loops and saturation curves (P_r - V_a) for each sample were obtained up to V_a of 10 V. Fatigue test was performed using a rectangular pulse train with varying V_a and a frequency of 500 kHz under 100 % duty condition up to 10^9 cycles.

Fatigue test of the four samples with varying V_{cy} shows a very interesting results as in Fig. 1. Here the degree of fatigue was defined as the ratio of P_r variation after 10^9 cycles (initial P_r, (P_r^i) - final P_r (P_r^f)) to P_r^i. First of all, the samples having high oxygen concentration in top electrode (5% and 10%) show high fatigue endurance properties compared to the samples having low oxygen concentration in top electrode (0% and 2%).

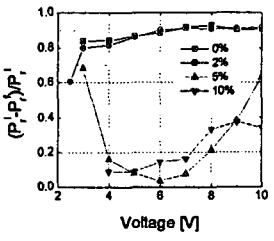

Figure 1. J-E Lim et al.