Comparison of structural and electrical properties of PMN-PT/LSCO thin films deposited on different substrates by pulsed laser deposition

Juan Jiang, Anupama Chanda Soon-Gil Yoon†

School of Nano Science and Technology, Chungnam National University

Abstract : The $0.65Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.35PbTiO_3$ (PMN-PT) thin films with $La_{0.5}Sr_{0.5}CoO_{3-\delta}$ (LSCO) bottom electrodes were grown on CeO_2/YSZ/Si(001), Pt/TiO_2/Si and $SrTiO_3$ (STO) substrates using conventional pulsed laser deposition (PLD) at a substrate temperature of 550°C. Since generally the crystallographic orientation of the bottom electrode induces the orientation of the films deposited on it, it allows us to observe the influence of the PMN-PT film orientation on the electrical properties. Phi scan done on PMN-PT/LSCO thin films shows epitaxial behavior of the films grown on STO substrates and CeO_2/YSZ buffered Si(001) substrates, and (110) texture on Pt/TiO_2/Si substrates. Polarization-electricfield (P-E) measurement shows good hysteresis behavior of PMN-PT films with remnant polarization of 18.2, 8.8, and 4.4μC/cm^2 on CeO_2/YSZ/Si, Pt/TiO2/Si and STO substrates respectively.

Key Words : Pulsed laser deposition, PMN-PT epitaxial films, LSCO bottom electrodes, electrical properties, perovskites

1. 서 론

Relaxor ferroelectric materials of PMN-PT have attracted great interest in recent years due to its unusual dielectric, piezoelectric, electro-optic and pyroelectric properties [1,2]. Since LSCO possess ABO_3 perovskite crystal structure and lattice parameters close to those of commonly used ferroelectric materials, it becomes a suitable candidate for growing oriented and epitaxial ferroelectric films [3]. In this paper, the influence of different substrates, buffer layers on the structural, and electrical properties of PMN-PT/LSCO/STO, PMN-PT/LSCO/CeO_2/YSZ/ Si, and PMN-PT/ LSCO/Pt/TiO_2/Si thin films prepared by pulsed laser deposition is studied.

2. 결과 및 토의

Phi scan was done which shows the epitaxial behavior of the PMN-PT/LSCO films on STO, CeO_2/YSZ/Si substrates and (110) texture on Pt/TiO_2/Si substrates. The dielectric constant calculated from capacitance-voltage (C-V) measurement shows dielectric constant of around 1798, 1612 and 1378 at a frequency of 10 kHz, on CeO_2/YSZ/Si, Pt/TiO_2/Si and STO substrates respectively. The Pt/PMN-PT/LSCO/STO, Pt/PMN-PT/LSCO/CeO_2/YSZ/Si capacitors show square shaped hysteresisloops with remanent polarization as large as 18.2, 8.8 μC/cm^2 with coercive field of 47, 43 kV/cm, respectively. In contrast, the P-E loop of the Pt/PMN-PT/LSCO/Pt/TiO_2/Si samples is much thinner, with lower remanent polarization of 4.4μC/cm^2 and coercive field of 32kV/cm. From this study, we concluded that the epitaxial nature of the films improves the dielectric response as well as influences the electrical behavior of the PMN-PT/LSCO films. Still, a large difference in Pr is observed which may be due to the influence of other mechanisms, probably related to the formation of a low dielectric, highly defective PMN-PT/LSCO interface layer.

감사의 글

This work was funded by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Ministry of Science and Technology (MOST) (Grant No. R01 -2007-000-21017-0) and by the KOSEF grant funded by the Ministry of Education, Science and Technology (MEST) (Grant No. 2009- 0079164). This work was also the outcome of a Manpower Development Program for Energy and Resources supported by the Ministry of Knowledge and Economy (MKE) and was supported by the Brain Korea 21 Project in 2006.

참고 문헌

[1] D. Viehland, M.C. Kim, Z. Xu, and J. F. Li, Appl. Phys. Lett. Vol. 67, p. 2471, 1995.
[2] Z.G. Ye, and M. Dong, J. Appl. Phys. Vol. 87, p. 2312, 2000.
[3] J.T. Cheung, P.E.D. Morgan, D.H. Lowndes, X.Y. Zheng, and J. Breen, Appl. Phys. Lett. Vol. 62, p. 2045, 1993.

† 교신저자) 윤순길, e-amil: sgyoon@cnu.ac.kr Tel: 042-821-6638
주소: 대전 충남대학교 공과대학1호관 304호