Ferroelectromagnetic Properties of $BiFeO_3$-$BaTiO_3$ Thin Films

Chae Il Cheon*[1], Jeong Seog Kim[1] and Pyung Woo Jang[2]
[1]Dept. of Materials Science and Engineering, Hoseo University, Asan, Chungnam, 336-795 Korea
[2]Dept. of Physics, Chongju University, Chongju, Chungbuk, 360-764 Korea

*Corresponding author: e-mail:cicheon@office.hoseo.ac.kr, Phone: +82 41 540 5763, Fax: +82 41 548 3502

Ferroelectromagnetic materials, which show ferroelectricity and ferromagnetism simultaneously, have been an interesting subject not only for the possible applications in the electronic devices but also from the view point of materials science. Recently, ferroelectromagnetic property on $BiFeO_3$ or $BiFeO_3$-$BaTiO_3$ thin films has been reported.[1,2] Ueda et al. reported that the epitaxial $0.7BiFeO_3$-$0.3BaTiO_3$ thin film prepared by PLD showed ferroelectricity (P_r = 2.5 μ C/cm^2) and ferromagnetism (M_r = 0.2 emu/g) simultaneously at room temperature.[1] Epitaxial thin films grown by PLD has also been reported to show P_s = 50~90 μ C/cm^2 and M_s = 5~150 emu/cm^3 at room temperature.[2] Kumar et al. have explored the crystal structure and the magnetic property of (1-x)$BiFeO_3$-x$BaTiO_3$ solid solutions and showed the field induced ferromagnetism at low temperature in the rhombohedral phase with the composition of $x < 0.3$.[3] They reported that the remanant magnetization(M_r) and coercive field(H_c) of the $0.8BiFeO_3$-$0.2BaTiO_3$ ceramic were 0.8 emu/g and 2.2 kOe. The reported values of ferroelectric and ferromagnetic properties are inconsistent and depend on the manufacturing process in $BiFeO_3$ or $BiFeO_3$-$BaTiO_3$. The origin of ferroelectromagnetism in these materials is also unclear up to now.

In this work, ferroelecromagnetic properties of (1-x)$BiFeO_3$-x$BaTiO_3$ (x = 0~0.3) thin films were studied. (1-x)$BiFeO_3$-x$BaTiO_3$ thin films were prepared on Si substrates by chemical solution deposition. Magnetic properties were measured using VSM(vibrating sample magnetometer) and SQUID (Quantum Design, MPMS5) in the temperature range of 300K ~ 5K. Dielectric and ferroelectric properties of the thin films were measured using impedance analyzer(HP 4192A) and ferroelectric tester (Radiant Technologies, Ltd., RT66A) at room temperature. Ferroelectric and magnetic properties of (1-x)$BiFeO_3$-x$BaTiO_3$ thin films with x = 0~0.3 will be presented.

References

[1] K. Ueda, H. Tabata and T. Kawai, Appl. Phys. Lett., Vol. 75, No. 4, 555-557, 1999.
[2] J. Wang et al., Science, Vol. 299, 1719-1722, 2003.
[3] M. Mahesh Kumar et al., J. Magn. Magn. Mater., Vol. 188, 203, 1988.