Solid State Science and Technology, Vol. 15, No 2 (2007) 103-111

ISSN 0128-7389

FABRICATION OF Sr1-xBaxBi4Ti4O15 THIN FILMS FOR PIEZOELECTRIC PRESSURE SENSORS

Nor Azlian Abdul Manafa, Muhamad Mat Salleha and Muhammad Yahayab

[a]Institute of Microengineering and Nanoelectronic (IMEN),

[b]School of Applied Physics, Faculty of Science & Technology,

Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

ABSTRACT

This paper reports the fabrication of Strontium Barium Bismuth Titanate Sr_1-xBaxBi$_4$Ti$_4$O$_{15}$ (SBBT) thin films for piezoelectric pressure sensors. The SBBT films and capacitance devices with structure of Al/TiO2/SBBT/TiO_2/SiO_2/Si were fabricated using sol-gel technique. The microstructure of SBBT thin films have been systematically studied in as-prepared (un-annealed) condition as well as after annealing at 50^0 C for 2 mins. The general trend seems to indicate that the annealed samples showed better piezoelectric properties. X-ray diffraction patterns reveal changes of crystalline structure after annealing. Another important parameter is dielectric constant, which is found toward higher value after annealing. For the sensor device measurement, the SBBT thin film pressure sensors were tested by pneumatic loading method at pressure range between 0 to 450 kPa. It was found that the sensor was sensitive to applied pressure and the response recovered back when the pressure removed. An annealed pressure sensor demonstrates better sensitivity and repeatability compared to un-annealed. The results indicated that the sensor performance was affected by the structure of the film. A crystalline structure gives an optimum response towards pneumatic pressure. The correlation between annealing process with structure of SBBT and piezoelectric property will be discussed.

http://journal.masshp.net/wp-content/uploads/Journal/2007/Jilid%202/Nor%20Azlian%20Abdul%20Manafa%20103-111.pdf

REFERENCES

[1]. Tandaske, D. (1984); Pressure sensors: selection and application, Marcel Deaker, New York, p. 73-75, 271-277.

[2]. Xie, D., Pan, W. and Shi, H. (2003); Synthesis and characterization of Sr1-xBaxBi4Ti4O15 ferroelectric materials, Material science and Engineering B, Vol. 99, No. 1-3.

[3]. Xu, Y. (1991); Ferroelectric materials and their application, North-Holland.

[4]. Yamaguci, M. and Nagotomo, T. (1999); Preparation and properties of Bi4Ti3O12 thin film grown at low substrate temperature, Thin Solid Film, p. 294-298.

[5]. Wu, W., Fumoto, K., Oishi, Y., Okuyama, M. and Hamakawa, Y. (1995); Preparation of bismuth titanate thin film, Japanese Journal of Applied Physics, Part 1, pp. 5141-5145.

[6]. Jordan, T.L. and Ounaies, Z. (2001); Piezoelectric ceramics characterization, ICASE, NASA Langley Research Center, Hampton, Virgina.

[7]. Ren, S.B., Lu, C.J., Liu, J.S., Shen H.M. and Wang, Y.N. (1996); Size-related ferroelectric domain structure transition in a polycrystalline PbTiO3 thin film, Physical Review B, Vol. 54 No. 20, p 14337-14340.

[8]. Lu, C.J., Ren, S.B., Liu, J.S., Shen, H.M. and Wang, Y.N. (1996); The effect of grain size on domain structure in unsupported PbTiO3 thin films, Journal Physics: Matter, Vol. 8, p. 8011-8016.

[9]. Liu, X.H., Liu, Z.G., Yin, J. & Liu, J.M. (2002); Microstructure and electrical properties of ferroelectric Pb(Zr0.53Ti0.47)O3 films on Si with TiO2 buffer layers. J. Phys.: Condens. Matter, 12, 9198-9194.