Effects of UV-ozone photo-annealing on surface, electrical properties, and chemical bonds of $BaTiO_3$ thin films deposited by sol-gel method

An-Hsiu Cheng[1], Sheng-Yuan Chu[1]

[1] *Department of Electrical Engineering, National Cheng Kung University, Tainan 701, Taiwan*
Corresponding author: chusy@mail.ncku.edu.tw

Keywords: UV-ozone, $BaTiO_3$, thin films

Barium titanate (BTO), an oxide with the perovskite structure that can be used as ferroelectric materials under Curie temperature, exhibits a wide bandgap of 3.2 eV indicating a promising insulating property [1].To achieve a less complex and high permitty, BTO combined with solution-process property was developed. Several approaches for the solution processing of thin film from various metal-organic precursors have been reported, including composition control, microwave annealing, the use of low-temperature-decomposable precursors, and deep-ultraviolet (DUV) photo-annealing. Among these method, DUV photo-annealing is used in the present study due to high degrees of sol-gel condensation and film densification and thus improve thin film performance [2]. However, the effects of DUV photo-annealing on the properties of BTO films have not been investigated yet.

In this article, BTO thin films were deposited on pure p-tpye Si substrates by spin-coating. The dried, as-prepared films were photo-annealed by UV-ozone for 0–180 min, and then annealed in a tube furnace at 250 ℃ for 1 h. The optimized surface energy (γs) (45.52 mJ/m^2) is obtained for BTO with 150 min UV-ozone illumination, indicating the improvement of adhesion properties for followed metal deposition process [3]. For electrical measurement, Al films were deposited on the BTO film as metal/insulator/semiconductor (Al/BTO/Si) structure. The lowest leakage cuurent density (5.66 × 10^{-12} A/cm^2) was also obtained.

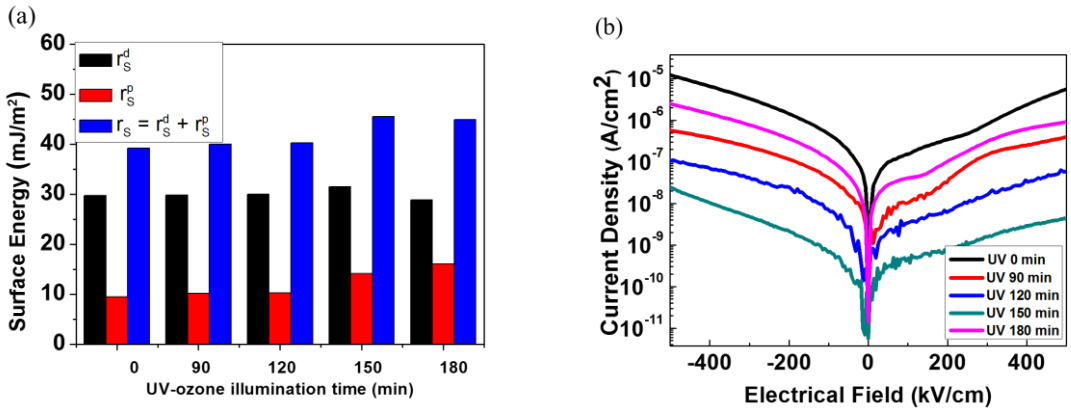

Fig. 1 (a) Surface energy (γs) of BTO thin films as a function of UV-ozone treatment duration, (b) Leakage current density versus applied electric field (J−E) for the metal/insulator/semiconductor structure, and

In summary, UV-ozone-treated BTO thin film showed a high surface energy of 45.52 mJ/m^2, low leakage current density of 5.66 × 10^{-12} A/cm^2 compared with those of prinstine BTO films (surface energy of 39.17 mJ/m^2, leakage current density of 1.46 × 10^{-9} A/cm^2).

References

1. C. Hagendorf, K.-M. Schindler, T. Doege and H. Neddermeyer, *Surf. Sci* **436**, 121-130 (1999).
2. Y. H. Kim, J. S. Heo, T. H. Kim, S. Park, M. H. Yoon, J. Kim, M. S. Oh, G. R. Yi, Y. Y. Noh and S. K. Park, *Nature* **489**, 128 (2012).
3. Y. C. Chen, P. C. Kao, Y. C. Fang, H. H. Huang, and S. Y. Chu, *Appl. Phys. Lett.* **98**, 263301 (2011).