Improvement of $BaTa_2O_6$ Thin Films for TFT Gate Insulator Applications

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$BaTa_2O_6$ is considered one of the candidate materials as the gate oxide of the oxide based TFTs. However, there are not many studies on this material to optimize its fabrication conditions. The lack of research on $BaTa_2O_6$ requires more deep studies especially in improving the electrical properties of the film. In our study, the $BaTa_2O_6$ film was deposited on Pt/TiOx/SiO_2/Si substrates by the rf-sputtering method with the base pressure is lower than 10^{-5}Pa. We fixed the working pressure and the rf-power as 2Pa and 80W, respectively, and varies its deposition temperature and oxygen partial pressure. After that, the films were annealed in oxygen atmosphere at 500^{o}C and were measured by the X-ray diffraction (XRD) to confirm its crystallinity. Subsequently, the Pt electrodes were fabricated on the film to measure the dielectric constant and leakage current.

Firstly, the $BaTa_2O_6$ films were deposited with the substrate temperatures at 100-450^{o}C. The XRD results indicated that all substrates are amorphous. The dielectric constant raised when the substrate temperature is increased while the leakage current is changed fluctuate. The optimal substrate temperature was chosen as 450^{o}C.

Secondly, the influence of oxygen partial pressure was examined. The oxygen was diluted by argon with a concentration of 30-70%. However, the dielectric constant was almost constant and show quite high value of 50, which is quite high as an amorphous material (Fig.1) and higher than that of $SrTa_2O_6$ (about 40) reported in our previous work[1)]. In addition, the sample which derived oxygen partial pressure of 30% showed the lowest leakage current.

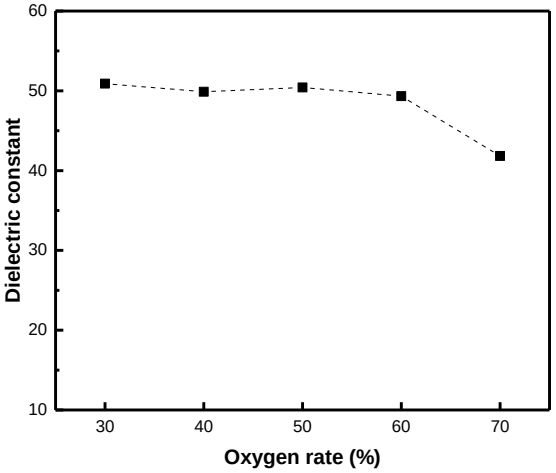

Fig. 1 Variation of dielectric constant of the $BaTa_2O_6$ films with the oxygen partial pressure

In conclusion, we successfully derived good $BaTa_2O_6$ film by rf-sputtering method, which dielectric constant exceeds 50 in the amorphous. Because of the high dielectric constant of $BaTa_2O_6$, we consider this material can improve IGZO-TFT properties when it is used as the gate material. Fabrication of IGZO-TFTs with a $BaTa_2O_6$ gate oxide is under investigation.

Reference

1. T. Takahashi et al., *Phys. Status Solidi A* **2018**, 1700773 (2018).