Structural and Electrical Properties of TiO2 Films by Controlled Deposition of Sol-Gel Process

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ABSTRACT

Regarding to the material of high dielectric layers, the characteristic of current leakage is very important, and being worth to study. However, related works and researches are few, especially in preparation of TiO2 nano thin film by the Sol-Gel method. In this paper, we studied the characteristics of TiO2 nano thin film, with changes the pH value of TiO2 solution formula, heat treatment temperature, film thickness and so on. And the TiO2 was deposited on ITO glass by spin coating, following high temperature furnace tube annealing. Surface morphology and electric characteristic were investigated. The experiment included three parts(i) thin film surface microstructure analysis ; (ii) thin film device measurement ; (iii) thin film optics and penetration coefficient measurement. TiO2 solution was prepared with titanium (IV) alkane oxygen compound (alkoxide) by Sol-Gel method. It was made from hydrolyzing of titanium-alkane oxide compound and water produced by esterification of acetic acid and IPA. This reaction may reduce the hydrolysis rate of the mellow oxygen compound to avoid fast precipitates, which led to produce homogeneous phase. By means of the TEM and SEM investigation, Sol-Gel pellets were 15-25nm in size, and the surface was extremely smooth. Brookite structure distinguished XRD. After annealing at 550℃, preferential crystallized texture and structure were formed. Al was taken as the point electrode of thin film device in I-V and C-V measurement. In order to study relation between leakage current, annealing temperature, and film thickness, different annealing temperature(200℃ to 600℃), film thickness and pH value of solution has been involved. As the result, there was a minimum leakeage current 1.2×10-8A with 7.53um thickness (4 layers) after 550℃ annealing. It might be attributed to the better crystallization and smooth surface. On the other hand, we also found that annealing can reduce the leakage current of TiO2 effectively, due to the compensation of oxygen left vacancy during prepare process. Titanium dioxide not only has stable chemical and physical properties, but also has excellent optical property. (photo-conductivity, reflectivity, refractive index and so on.) Besides, titanium dioxide also has good penetration coefficient. The penetration coefficient of TiO2 thin film is 80% measured by UV-Vis.

Keywords : Sol-Gel ; titanium dioxide ; thin film ; leakage current ; Dielectrics

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