

HIGH-K ZrO₂ THIN FILMS BY CHEMICAL SPRAY PYROLYSIS METHOD

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We report the deposition of zirconium oxide (ZrO₂) thin film by chemical spray pyrolysis at 200, 300, 400, and 500 °C. As-deposited zirconium oxide films were heat-treated at 500, 800 °C for one hour and their morphological, structural, optical, and electrical properties were investigated. Irrespective of the deposition temperature, the scanning electron microscope (SEM) images revealed that the deposited films were smooth and uniform.

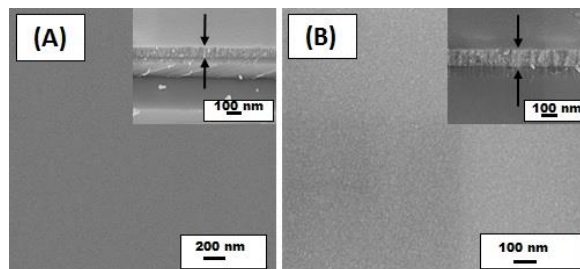


Figure 1 SEM images of ZrO₂ thin film as-deposited at 300 °C (A), and 500 °C (B) from 0.025M precursor solution. Their respective cross-section is shown in the inset of (A) and

The structural studies revealed that the ZrO₂ thin film deposited at 500 °C are poorly crystalline, while the films deposited below 500 °C were amorphous. In order to understand the phase composition in the ZrO₂ films, the X-ray diffraction peak was deconvoluted, and it revealed that ZrO₂ tetragonal phase was predominant upon annealing at 500 °C, with the monoclinic phase favoured after annealing at 800 °C, which was confirmed by Raman studies. As-deposited ZrO₂ thin film are optically transparent (above 80% in the visible region) with a slight decrease in transmittance upon annealing at higher temperature, while the optical band gap of ZrO₂ film is in the range 5.39 – 5.68 eV. The electrical properties was accessed by fabricating a CMOS-device with Al/ZrO₂/n-Si/Al structure and we obtained a dielectric constant (k) in the range 4.3 – 13.0 at 1 kHz depending on ZrO₂ film deposition temperature.



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