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# Growth of $ZrO_2$ Thin Films Using RF Magnetron Sputtering and Study of Their Surface Characteristics

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Thin films of $ZrO_2$ were deposited on Si(100) and Micro Cover glass substrates using RF magnetron sputtering technique. To study an influence of the sputtering parameters such as RF power magnitude, annealing temperature and reactive gas effect, etc. on the film structure and optical and electrical properties, a systematic study using XRD, ellipsometry, I-V and C-V was mainly carried out in this study. Moreover, the as-grown thin films were characterized with FT-IR, RBS, SEM, microhardness, contact angle measurements to analyze their surface characteristics. XRD showed that a highly oriented cubic $ZrO_2$ thin film in the <111> direction was obtained after annealing at 800℃. On the other hand, tetragonal $ZrO_2$ thin film was deposited above 800℃ of annealing temperature. Below 800℃, moreover only amorphous $ZrO_2$ thin films with cubic phase were grown. FTIR data showed a strong vibrational peak at 453$cm^{-1}$ due to Zr-O vibration. With increasing annealing temperature to 1200℃, however, another vibrational peak was also arised at 1081$cm^{-1}$. This means that at higher annealing temperature, the surface oxygen will be diffused into the bulk, resulting in a $SiO_2$ layer formation in the interface region. Contact angle measurements showed the nature of hydrophilic surface rather than that of silicon. The most proper deposition condition for $ZrO_2$ thin film growth was 150 watt of RF power, 800℃ of annealing temperature, 2 hours of deposition time. The hardness was also affected by the annealing temperature and those values were increased with increasing annealing temperature. From the I-V and C-V measurements, dielectric constant and leakage current density were also observed to be 5 and $1\times10^{-11}A/cm^2$.