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EFFECTS OF DRY OXIDATION TREATMENTS ON THE CHARACTERISTICS OF GALLIUM OXIDE THIN FILMS PREPARED USING SOL-GEL SPIN COATING METHOD

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ABSTRACT- In this paper, gallium oxide (Ga_2O_3) thin films were grown on silicon (Si) substrate using a relatively simple and low-cost sol-gel spin coating method followed dry oxidation process. Two series of dry oxidation experiments were conducted, i.e., (i) annealing at different oxygen flow rates (i.e., from 2 L/min – 5 L/min) under 1100°C, and (ii) annealing at oxygen flow rate of 5 L/min under different temperatures (i.e., from 800°C to 1100°C). The effects of the oxygen gas flow rates under different temperatures on the structural, surface morphology, and optical properties of the deposited films were investigated. All results revealed that crystalline Ga_2O_3 layers were formed. From the X-ray diffraction results, all deposited films exhibit two prominent diffraction peaks corresponding to the Ga_2O_3 (1 $\bar{1}$ 0) and (002). The annealing at different temperatures experiments showed that the surface roughness and the grains size increased as the temperature increases from 800°C to 1100°C. The optical band gap energy of the deposited films was extracted from the Ultraviolet-violet transmission spectra. This obtained energy bandgap is within the ranges of 4.69 – 4.83 eV, i.e., in reasonable agreement with the reported values. In summary, all the results showed that polycrystalline Ga_2O_3 thin films were able to be grown on p-Si (100) substrate through the proposed methodology. While the best conditions for the dry oxidation process are at the oxygen flowrate of 5 L/min at temperature of 1100°C.

Keywords: Gallium oxide, Sol-gel, Spin coating, Dry oxidation, Annealing, X-ray diffraction, Kubelka-Munk function.