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Thermochemical and Green Luminescence Analysis of Zinc Oxide Thin Films Grown on Sapphire by Chemical Vapor Deposition

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Abstract: This study has been carried out to detail an integral thermochemical analysis of the principal reaction in the production of zinc oxide (ZnO) thin films, including developing an analytical form of the equilibrium constant. Zinc oxide thin films prepared by chemical vapor deposition have been studied in terms of deposition time and substrate temperature. The growth of the single-crystal films present two regimes depending on the substrate temperature, with increasing constant growth rates at lower, and higher, temperature ranges, respectively. Growth rates above 6 μ m \cdot min^{-1} can be achieved at T_s = 880 K. The variation of the green luminescence intensities in ZnO single-crystal thin films according to the subsequent processing in hydrogen atmosphere have been studied. After annealing of each ZnO sample at different temperatures, the luminescence intensity is maximal for ● = 510 nm. It is established that the concentration of the oxygen vacancies could be controlled to within two orders of magnitude for temperatures less than 980 K. Beyond 980 K, defects of interstitial zinc is created in the ZnO films.

Key Words: Zinc oxide, chemical vapor deposition, thermochemical, activation energy, hydrogen annealing, green emission.

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