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Morphological Characterization of RF Magnetron Sputtered Zinc Oxide Thin Films -Laser Assisted

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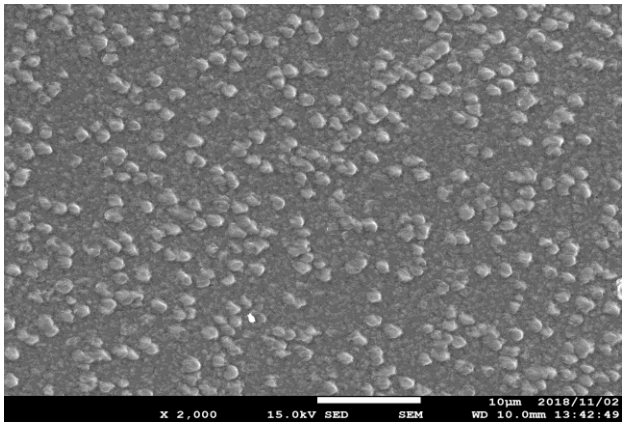
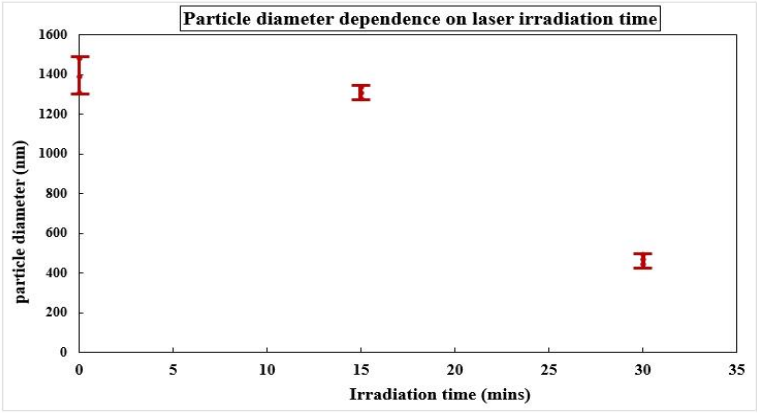
Zinc oxide (ZnO) thin films are fabricated using several techniques. Among the numerous fabrication methods, the radio frequency (RF) magnetron sputtering method is industrially adopted for deposition of homogeneous ZnO films on large areas due to advantages such as, high deposition rates, better reproducibility, high stability, good adhesion to substrate, uniformity in thickness and composition, and easy control of the composition of the films, compared to the other techniques [1]. Laser processing of materials involves their exposure to rapid and localized energy, which creates conditions of electronic and thermodynamic non-equilibrium. The laser induced heat can be localized in space and time, enabling excellent control over the manipulation of materials. Laser irradiation technique is used on thin films as an efficient method to improve the crystalline quality and increase the electron donors. Also, laser irradiation has several advantages, including fast crystallization at room temperature, possibility of local crystallization, crystallization of thin films on low melting point substrates, and increasing charge carriers through a photoconductivity effect [2].

In this study, ZnO thin films were deposited on a-sapphire, c-sapphire and synthetic quartz substrates for various magnetic field strengths (i.e. B=0 Gauss, B=167 Gauss and B=1200 Gauss) by RF magnetron sputtering technique using pure ZnO target of dimension (50ϕ x5t) mm^2. The effects of laser irradiation on the morphological properties of the ZnO-based thin films was investigated using solid state green laser of wavelength 532nm. Also, the effect of varying the magnetic field was investigated.

The surface morphologies and compositions of the ZnO thin films were analyzed using scanning electron microscopy. The micro structural parameters, such as the particle number density and crystallite average diameter were calculated as 0.175 [/um^2] and 1319nm respectively. Variation in the surface morphology of the thin films due to laser irradiation were observed. The surface morphological features of the laser irradiated films revealed the presence of crystalline grain size. UV-Vis spectroscopy was also used to investigate the optical properties of the ZnO thin films. With high magnetic field strength (i.e. B =1200 Gauss), the particle diameter decreased with increased laser irradiation time of substrate.





(a) **(b)**

Figure 1. (a) SEM Micrographs of the morphology of ZnO thin films with 15 minutes laser irradiation, (b) Particle dependence of laser irradiation time.

References

[1] Anil Kumar et al. // International Journal of Engineering Sciences & Research Technology, 5(8): August, 2016.

[2] S. Zhao, Y. Hua, R. Chen, J. Zhang, and P. Ji // Journal of Nanotechnology, Volume 2016, Article ID 9385725.