Abstract:

The growth and characterization of Pulse Laser Deposited (PLD) ZnSe thin films have been investigated. Films were grown by employing Excimer laser (100 mJ, 248 nm, 18 ns, 30 Hz) at various number of laser pulses i.e. 3000, 4000, 5000 and 6000. The films were grown by keeping substrate temperature at 300°C on both glass and silicon (Si) substrates. The effect of varying laser pulses on structural, surface, optical and electrical properties of PLD grown ZnSe thin films has been investigated. XRD, SEM and AFM analysis were performed to explore structural and surface behavior of the grown thin films. In order to investigate the thickness, and optical properties (absorption, transmission, band gap, extinction coefficient and refractive index) of deposited films ellipsometery technique and UV/Vis photospectroscopy techniques were employed. Four probe method was used to reveal the electrical behavior of deposited films. For the films deposited on glass substrate, two XRD phases with preferred orientation of $ZnSeO_3$ (2 1 2) and ZnSe (3 3 1) were identified. SEM analysis showed the growth of dendritic rods and cubical crystalline structures for the films grown at lower number of laser pulses i.e. 3000 and 4000 respectively. For increased number of pulses i.e. 5000 and 6000, the growth of uniform films is observed. The evaluated band gap energy varies from 3.1 eV to 3.5 eV for the films grown at 300°C substrate temperature with increasing number of laser pulses.

For the films deposited on Si substrate two peaks of $ZnSe_2O_5$ and ZnSe with preferred orientation along (1 1 2) and (2 0 3) planes are observed for the film grown at 3000 laser pulses. By increasing number of laser pulses from 3000 to 5000, it is observed that the intensity of both peaks as well as crystallinity increases. However, for maximum number of laser pulses i.e. 6000 the reduction in peak intensity and crytallinity is observed. SEM analysis shows that for lower number of laser pulses i.e. 3000 and 4000, film growth is uniform but higher number of pulses i.e. 5000 and 6000 are responsible for the growth films with non-uniform texture along with porous and dendritic structures. AFM analysis also confirms that the grown films are uniform for 3000 and 4000 number of pulses and non-uniform textures in form of valleys and bumps are formed for the films deposited 5000 and 6000 number of laser pulses. The RMS roughness of the films significantly varied between 5 nm to 20 nm. The thickness of grown films varies form 165 nm to 465 nm. The electrical conductivity of the deposited films increases by increasing number of pulses upto 5000, but at maximum number of laser pulses i.e.6000 it is decreased.