Summary

Of

UGC Sponsored Major Research Project

"**Studies and Applications of II-VI Compound Based Semiconducting Devices**"

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Summary

Stacked layered deposition of CdTe and ZnTe thin films by RF Magnetron sputtering method and subsequent annealing in vacuum, argon and nitrogen environment, lead to the formation of $Cd_{1-x}Zn_xTe$ in all the samples with proposed stoichiometries. Increased inertness of the annealing environment has led to improved crystalline formation of $Cd_{1-x}Zn_xTe$ with increased Te precipitation. Photogenerated gain initially increased and then started decreasing with percentage increase of Zn in $Cd_{1-x}Zn_xTe$ thin film. Stacked layered deposition of CdTe and Zn by vacuum evaporation and consequent vacuum annealing has revealed incorporation kinematics of Zn into CdTe crystal. Sigmoidal growth of lattice constant of $Cd_{1-x}Zn_xTe$ against temperature is observed and is regressed by Boltzmann and Logistic curves. Maximum change of lattice-constant is occurring in between 375-400℃ and 425-450℃. Zn diffusion into CdTe was basically a two-staged process and diffusion is at a much faster rate in-between 375-400℃, as compared to 425-450℃. It is observed that charge impurities and defects reduced the transmittance value and consequently the band-gap of the compounds. SEM micrographs suggested that film granularity reduced along with the increasing annealing temperature. Air-annealing in furnace of stacked CdTe/Zn multilayers lead to formation of $Cd_{1-x}Zn_xTe$/ZnO core-shells. $Cd_{1-x}Zn_xTe$ formation reached saturation by 500℃, where as ZnO formation speeded up in between 550-600℃. Band-gap of the heterostructures is less than that of individual CdTe, ZnTe or ZnO chiefly because of staggered type-II band alignment like that of $Cd_{1-x}Zn_xTe$/ZnO hetero-structures. $Cd_{1-x}Zn_xTe$ particle size followed an exponential growth against annealing temperature and SEM images reflected reduced surface granularity with increasing Zn percentage in $Cd_{1-x}Zn_xTe$. SEM micrographs also revealed growth of fibre like formations of ZnO on film surface with increasing annealing temperature. Stacked layered deposition of compound CdTe and ZnTe thin films and subsequent air-annealing in furnace led to formation of highly poly-crystalline $Cd_{1-x}Zn_xTe$ films. The annealed films showed increasing crystallinity with increasing annealing temperature and time. The particle size showed a sigmoid growth curve against temperature and time, while strain, dislocation density and number of crystallites/unit area showed a sigmoid-decay curve. Wire like TeO_2 formation started occurring in samples at high annealed temperatures, which on further annealing started occurring in clusters. The results eventually suggested that stoichiometric polycrystalline $Cd_{1-x}Zn_xTe$ thin films could be prepared by annealing CdTe/ZnTe multilayers in air using cheap box-furnaces.