Title: Effect of Laser, Gamma-ray and Swift Heavy Ion Irradiation on Compound Semiconductors

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ABSTRACT

In the last several decades, compound semiconductor develops more interest of researchers because they have potential applications in optoelectronic fields such as displays, sensors, microwave communication, solar cells, optical communication and radiation detector etc. One of the major advantage of compound semiconductors over elemental semiconductors like silicon and germanium is that they make available the device engineer, a wide variety of energy gaps and mobilities, so that materials are available with properties that meet specific requirements. My interest in the selenium based compound semiconductors has been developed over a period of years because of its potential applications in various optoelectronic devices. The aim of this thesis work is to improve the properties of selenium by addition of different dopants, and by different irradiation techniques for enhancing the efficiencies of various optoelectronic devices. In this study, I have systematically carried out these irradiation effects on the Se-based compound semiconductor thin films deposited by thermal evaporation technique. The investigated compound semiconductor thin films deposited by thermal evaporation technique are: $Se_{90-x}Hg_xS_{10}$ (x = 0, 5, 10, 15), $Ga_{10}Se_{85}Sn_5$, $Ga_{10}Se_{80}Hg_{10}$, $Se_{85}S_{10}Zn_5$, $Ga_{10}Se_{90-x}Al_x$(x = 0, 5).

In chapter 3, the laser irradiation effect on the structural, optical and electrical properties of amorphous $Se_{90-x}Hg_xS_{10}$ (x = 0, 5, 10, 15) thin films has been studied in detail. Thin films of the

investigated material were irradiated by TEA N_2 pulsed laser at different durations of time. The investigated thin films were characterized by different techniques like XRD, FESEM, AFM, UV-vis-spectrophotometer, dark d.c conductivity and photo-conductivity measurements. The characterized analysis shows an enhancement in absorption coefficient and electrical conductivity with laser irradiation time.

The effect of gamma irradiation on structural and optical properties of polycrystalline $Ga_{10}Se_{85}Sn_5$ and $Ga_{10}Se_{80}Hg_{10}$ thin films has been studied in chapter 4. The investigated thin film was irradiated by ^{60}Co gamma rays by 50-150 kGy doses, available at Inter-University Accelerator Center New Delhi, India. The samples were characterized by XRD, SEM, AFM, Raman and UV-vis-spectrophotometer for studying the structural and optical properties. The results showed that optical band gap of investigated thin films decreases and the corresponding absorption coefficient increases continuously with increasing the dose of gamma irradiation, which is explained in detail in terms of bond distribution model.

In Chapter 5 we have discussed the swift heavy ion irradiation effect on the structural, optical and electrical properties of $Se_{85}S_{10}Zn_5$ and $Ga_{10}Se_{90-x}Al_x$(x = 0, 5) thin films. The $Se_{85}S_{10}Zn_5$ thin films were irradiated by 120 MeV Ag^{9+} ions whereas thin films of $Ga_{10}Se_{90-x}Al_x$(x = 0, 5) were irradiated by 100 MeV F^{7+} ions using 15UD Pelletron Accelerator facility at IUAC, New Delhi, India. The investigated thin films were characterized by XRD, SEM, Raman, UV-vis-spectrophotometer and dc conductivity measurements. The results shows the reduction of optical band gap of $Se_{85}S_{10}Zn_5$ thin films after SHI irradiation. The scanning electron microscopy of $Ga_{10}Se_{90-x}Al_x$(x = 0, 5) thin films revealed that the defects or disorder has been increased after swift heavy ion irradiation.