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Thesis Title	Laser Induced Effects on Semiconductors and Their Spectroscopic Characterization.

Abstract

In this thesis we have studied the effects of laser irradiation on cadmium selenide (CdSe), Cd_xSe_{100-x} (x = 54, 34) and Cadmium Sulfide (CdS) semiconductor thin films. Lasers of different energies and different wavelengths were used for investigations. To start with, $Cd_{54}Se_{46}$ and $Cd_{34}Se_{66}$ powders were prepared by melt quenching technique. Powders of Cd_xSe_{100-x} and CdSe (high purity 99.995% from Alfa Aesar company) were deposited on a glass substrate using the thermal evaporation technique at room temperature .These materials show that the crystalline nature and the particle size decreased when the Se concentration increased in the system. The photoconductivity is found to enhance with selenium content in the Cd_xSe_{100-x} thin films.

Our studies reveal that the structure and optical properties of $Cd_{54}Se_{46}$ thin films are changed on irradiation with N_2 laser of energies 100 µJ and 1 mJ and with Nd:YAG laser of energy 2 mJ. The optical absorption spectra of $Cd_{54}Se_{46}$ thin films were studied before as well as after irradiation with N_2 lasers. The optical band gap of $Cd_{54}Se_{46}$ thin film is decreased and the absorption coefficient (α) is increased after laser irradiation. Laser irradiation further results in the increase of the crystallite size of the thin films as revealed by XRD results. The particle size of the film is changed to larger clusters with apparent crystallization. Similarly, irradiation of $Cd_{54}Se_{46}$ thin films with Nd:YAG laser of energy 2mJ results in increase of the optical band gap and decrease of the absorption coefficient. However, in contrast to N_2 laser irradiation, exposure with Nd: AG laser causes decrease in the crystalline size of the thin film.

In another study of the effect of variation of laser wavelengths on structure and optical properties of $Cd_{34}Se_{66}$ thin films, it is found that their properties are changed by irradiating with N_2 and Nd:YAG lasers of different wavelengths. Irradiation with N_2 laser pulses of wavelength of 337.1 nm causes up to three-fold increase of the crystallite size, associated with structural transformation from hexagonal to cubic. Also, the optical band gap is slightly decreased due to increase of the crystallite size. However, irradiation by Nd:YAG laser of wavelength of 532 nm results in the decrease of crystallite size by two fold, but without any phase structural change.

This is accompanied by a considerable increase in the optical band gap due to the nanostructure phase and defect states decrease in the mobility gap.

We have also studied N_2 laser irradiation effect on FTIR and photoconductivity of Cd_xSe_{100-x} thin films. In the FTIR spectrum, the peak of thin film is shifted towards higher wave numbers due to increase of the crystallite size of thin films.

The Photoconductivity measurements were carried out on Cd_xSe_{100-x} thin films on laser irradiation which causes as increase in the photosensitivity of the films. Enhancement of photoconductivity, photosensitivity and transient photoconductivity of the thin films after laser irradiation is due to decrease in the density of defects and increase in the crystallite size, signifying that the number of grain boundaries is decreased.

We also studied the effect of laser on the amorphous thin films of CdS. The optical band gap of CdS thin film is decreased and the absorption coefficient is increased. The XRD data show that the crystalline nature of the film is increased and its structure is changed from cubic (ZB) to hexagonal (W). Furthermore, laser irradiation of CdS thin film resulted an increase in the crystalline size and decrease in the optical band gap. Also, the photoconductivity of the thin film and its photosensitivity are enhanced after laser irradiation. This is due to increase in the crystalline size and decrease in the grain boundary of CdS thin films.

Next, we have studied the effect of Nd:YAG laser irradiation on the structural and optical properties of CdSe thin films. It is found that the crystallite size decreases and the optical band gap increases after laser irradiation. The peak of the thin film in the FTIR spectrum is shifted towards higher wave numbers after N_2 laser irradiation, which is due to increase in the crystallite size and the structure.