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Study of Optical Parameters of the Thin Films of $Se_{100-x}Hg_x$ with Laser Irradiation

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***Abstract*— In this study the bulk samples of $Se_{100-x}Hg_x$ (x = 0, 5, 15) have been prapered by conventional melt quenching technique. The thin films of the material were prepared by thermal evaporation technique. These thin films were irradiated with pulsed diode laser of wavelength 405 nm and power 100 mW for different durations of time. The transmission spectra was recorded by UV- visible spectrophotometer (200-1100nm) before and after irradiation. The transmission spectra has been studied to measure the optical constants like extinction coefficient (k), absorption coefficient (α), optical band gap (E_g) and urbach's energy (E_e). It has been found that the value of absorption coefficient and extinction coefficient increases after irradiation. Also the Urbach's energy increases and the optical band gap decreases after irradiation. This indicates that the irradiation induces variety of defect states in the material system. It has also been found that the change of these optical parameters is more if the concentration of mercury is increased. This may be due to the addition of mercury and the bonding arrangement of the material system changes. These materials are found suitable for optoelectronic devices due to their high absorption coefficient.**

***Index Terms*— Optical Bandgap, Extinction coefficient, absorption coefficient and urbach's energy.**

I. INTRODUCTION

Chalcogenide glasses are amorphous compositions derived from key chalcogen elements i.e., S, Se, Te. These chalcogenides have many unique optical properties, which can be used for a wide variety of applications [1]. From the last three decades, much more interest has been paid for the development and characterization of the chalcogenide glasses. They have lot of important optical application like solar cells, infrared power delivery, optical limiting, manufacture of filters, IR emitter, optical rewritable data, antireflection coating, IR detector, gratings and optical recording media [2-8]. From these optoelectronic applications, it becomes more interesting to study the optical properties of these chalcogenide semiconductors and also study how these optical parameters are further modified by different techniques in which one of the interesting technique is to irradiate these chacogenide semiconductor thin films by laser. Numerous studies have already been done about the effect of laser radiation on the optical parameters of the various chalcogenide semiconductors [9,10]. In the present work, we study the effect of pulsed diode laser of wavelength 405nm and power 100mW irradiation on the thin film system of **$Se_{100-x}Hg_x$ (x = 0, 5, 15)** at different duration of time, and found that the optical bandgap is decreased with pulse duration, and all other optical parameters are also modified discussed in the present study. It is clear from these optical parameters that has been changed after irradiation, whenever an electromagnetic radiation interacts with the material, it may interacts with the electrons of an atom, may accelerate them and hence in this way energy is absorbed by these electrons. This energy is transferred to the lattice through electron - phonon interaction. On the other hand, in semiconductors the absorption of photons leads to the creation of electron – hole pairs with a certain amount of kinetic energy. These hot carriers thermalize amongst each other forming plasma [11]. Once a common carrier temperature is reached, they transfer their kinetic energy to the lattice via recombination and phonon generation. In both these ways the lattice vibration increases cause heating and melting. This leads to the formation of some kinds of defects in the sample. In this way the structure of the sample has been changed and hence the optical properties are modified and hence enhance the industrial optoelectronic applications of chalcogenide semiconductors.

II. EXPERIMENTAL DETAILS

The samples of **$Se_{100-x}Hg_x$ (x = 0, 5, 15)** was prepared by melt quenching method. First of all the composition of selenium and mercury has been taken according to their atomic percentage. The mixtures were put into different quartz ampoules, in which the pressure of the ampoules were kept at 10^{-5}torr and then sealed. These ampoules were kept in the furnace at a temperature of 1000 K for 10 h. For achieving homogeneous mixture, these ampoules have been continuously rotated in furnace. After 10 h these ampoules are taken out from the furnace and quenched in ice cooled water. Thin films of **$Se_{100-x}Hg_x$** different concentrations were deposited on glass substrates using thermal evaporation technique at room temperature under a vacuum of10^{-5}torr, achieved through a molybdenum boat. The glass slides was cleaned by ultrasonic bath and then by acetone. The thickness of these films were measured to be 300nm. These films were irradiated with a pulsed diode laser of wavelength 405 nm and power 100mW for different

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