Chapter - VI

GENERAL CONCLUSION AND SCOPE FOR FUTURE WORKS
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GENERAL CONCLUSION AND SCOPE FOR FUTURE DIRECTIONS

In our present investigations we have carried out investigations on optoelectronic characterization of CdTe thin films, preparation of CdS thin films and its optical characterization and finally synthesis and characterization of CdS nanocrystals embedded in PVA matrix. For CdTe thin films we have used some unanalyzed data of our previous workers to understand the basic mechanism of photoconductivity as the sample is most suitable for high theoretical efficiency solar cell. By observing photoconductivity rise and decay (transient response) along with temperature dependent of photoconductivity we have been successful in understanding the role of trapping and recombination process in controlling the photoconductivity. The role of substrate temperature in the process of CdTe film formation (grain growth), effect of grain boundary potential barrier in photoconductivity process, effect of temperature, intensity of illumination and bias voltage have been clearly understood. The complex mechanism of photoconductivity in polycrystalline thin films whether due to generation of carrier density (number modulation) and reduction of barrier height (barrier modulation) is yet to be fully understood. The present study on CdTe thin films have provided us some information relating to photoconductivity mechanism in vacuum deposited CdTe thin films. Further exhaustive studies on CdTe thin film is necessary for application of CdTe film as better absorbing layer in fabrication of solar cells. The process of vacuum evaporation is suitable for small area thin
films. Large area thin films are required for fabrication of large area solar cell module. Studies on preparation of such large area solar cell by suitable technique are yet to be completed. Interest in the preparation of CdTe films at low substrate temperature (liquid nitrogen temperature) and post deposition treatment like annealing may change to large and columnar grain to improve the efficiency and performance of solar cells. From the survey of literature it is seen that preparation and characterization of CdTe thin films for various applications is still carried out widely and a major area of research at present.

In our next attempt we have been successful to grow CdS thin films by chemical bath deposition (CBD) and its characterization by various techniques. It has been observed by investigations that CBD is very suitable low cost, simple technique to grow CdS thin films. The effect of bath parameters specifically the effect of pH variation in formation of CdS thin films have been understood by the investigation. The familiarity with various sophisticated instruments specifically with AFM and SEM has been fruitful to add knowledge during the research work. Optical absorption and emission (PL) studies have shown that these techniques are suitable non-destructive techniques of precisely characterizing semiconductor thin films. They are suitable to understand optical, structural and electronic properties of semiconductor thin films. Post deposition etching and annealing process is necessary to improve film quality. Further exhaustive studies in this area may provide useful information in future research. The effect of ageing on stability of structure and properties of CdS thin films also need further investigations. Detail studies on photoconductivity and response to various optical signal for applications in robotic and control system can be carried out as further study of CBD grown CdS thin film. Inspite of being a well
established photoconducting material the reason for apparent dead layer properties in the heterojunction solar cell cannot be understood. Detail studies in this line on CBD thin films of CdS will be another interesting topic.

Finally by synthesizing CdS nanoparticles in PVA matrix and its subsequent characterization by optical, XRD, SEM and AFM has given us experience to be familiar with the small and beautiful world of nanotechnology. The field of nanotechnology is not only beautiful but wonderful and exciting. We have been successful in synthesizing CdS nanoparticles embedded in PVA matrix by chemical route. Nanocrystals of size within the range 6.3 nm to 10.2 nm have been obtained. Band gap have been found to increase with decreasing particle size indicating possibility of band gap tailoring in such material. Quantum size effects have been observed in CdS nanocrystals with shifting of absorption edge to blue region. The defect PL emission peaks have been found to be intense and broad as compared to CdS thin films deposited by CBD technique. The effect of synthesizing CdS nanocrystalline film on polyethylene and mica substrate have shown very interesting results which need detail systematic investigations for applications of nanomaterials in fabrication of foldable and light weight electronic and optoelectronic device. The application of AFM in obtaining proper image is very difficult and needs systematic investigations. The application of High Resolution TEM (HRTEM) is very essential to corroborate the results of size determination. Other characterization to be carried out include applications of Field emission SEM (FESEM), Laser Raman spectroscopy for size determination as nanocrystal size plays the important role in changing the properties of materials.

Further work to be extended is synthesizing nanomaterials of other II-VI compounds like ZnS, CdSe, CdTe, ZnO etc. for various other applications. Doping
may enhance optical absorption and reduce particle size making it efficient for various devices. To increase the electrical property of quantum dot assembly, conducting polymer may be used to conduct single electrons from dot to dot through matrix and increase the quantum efficiency of devices. Biosynthesis of CdS as photosensitive materials of visible radiation may be useful in medical science for fabrication of artificial eye.