CHAPTER 8
Summary and future perspectives

Chapter 8

Thin films of II-VI semiconductor materials attract more attention, and thin-film technology is now one of the most promising fields of research, with materials playing an important role due to their potential applications in optoelectronic devices. CdS thin film can be utilized as an absorber layer in solar cells and as an active layer in optoelectronic devices in II-VI semiconductor thin films. II-VI material thin films have a good bandgap, better absorption coefficient, and reproducible deposition procedures capable of large volume and low cost of manufacturing are all essential selection requirements. These nanocomposite thin films have an essential function in a variety of scientific and industrial fields. Thin-film electronics applications are becoming more important in many gadgets, according to recent advancements in the field. Because of its characteristics such as better transmittance in the visible range and excellent electrical conductivity is an interesting feature for many optoelectronic applications. The primary objective of this study is to fabricate RF Sputtered nanocomposite thin film coated glass and soda-lime substrate prepared by reactive RF magnetron sputtering technique and their multifunctional were accomplished. The properties of RF sputtered thin film are greatly influenced by the deposition parameters such as deposition time, RF power, temperature, reactive gas flow rate, and optimizing the process parameters is significant. With this perspective, we tried to adjust and optimize the processing parameters for RF magnetron sputtering for fabricating different Nano composite thin films.

The nanostructure thin film was deposited on a flexible substrate by sputtering at different oxygen ratios, different substrate temperatures, different RF power, and different deposition time to improve the crystalline, electrical, and optical properties of the films. Sputtering can also help with film deposition on substrates. Furthermore, the comparatively rapid rate of growth during the sputtering process reduces the risk of contaminants being incorporated into the characterized thin films. The structure, morphology, chemical characteristics, electrical and optical properties of the materials prepared were studied using various characterization techniques such as X-ray diffraction, optical transmission studies, electrical resistivity analysis, energy dispersive x-ray assessment, scanning electron microscopy, and so on. X-ray diffraction (XRD) was used to determine the crystallographic structure of the thin films, interplanar spacing, crystalline size, dislocation density, microstrain, texturing coefficient, and stacking fault probability. A field emission scanning microscope was used to examine the surface morphology of the deposited films. Using a double beam spectrophotometer, the optical reflectance spectra of the films were analyzed to estimate the optical bandgap and porosity of the films. Fourier transform infrared, Raman, and X-ray photoelectron spectroscopy were used to examine the functional and chemical composition of the films grown on thin film. The analysis of RF plasma during the sputtering process is another essential part of this research. Four probe methods and optical emission and transmission spectral studies were used to accomplish this. By depositing the thin films under various conditions, the RF sputtered thin films were optimized. The transparency and conductivity of the films can also be improved after they were heat-treated under high vacuum conditions after deposition. The best figure of merit was obtained with an annealing temperature, deposition time, and RF power. Another key factor affecting the characteristics of RF sputtered thin films is the deposition pressure. Increases in RF Power, deposition time, and substrate temperature up to a specific value enhance the formation of crystalline films with higher electrical and optical properties. The effect of RF power on the film's characteristics was also explored. The films that were deposited at a higher RF power had a higher figure of merit. The film properties were associated with the plasma parameters after a simultaneous measurement of the plasma parameters. Flexible devices are now becoming an essential aspect of research and industry. The processing temperature for deposition on flexible substrates will be reduced. The plasma parameters were also shown to have a link to the reported film qualities. The optimized RF sputtered nanocomposite thin films can be employed in a variety of devices, thin-film transistors, and transparent thin-film solar cell applications.

Scope of the future work

In the present research, an attempt is made to improve the electrical conductivity of thin films by the sputtering method. Even though good results have been obtained, the efficiency of thin-film solar cells is not on par with this as seen from the results.

Extensive investigations on broad band-gap material thin films, optical characteristics such as band-gap, transparency, thickness, and refractive index are achievable. The morphology and microstructure of the RF sputtered thin films also have an impact on the optical characteristics. As a result, the surface structure must be optimized for control of porosity and varied morphologies.

RF sputtered thin films of various thicknesses demonstrated excellent optical transparency and a wide band-gap, as well as increased crystallinity and reduced surface roughness when exposed to an electron radiation. In addition, the bi-layer structure exhibited maximum transparency, low roughness, and good crystallinity. As a result, it might be used to investigate the impact of electron irradiation on bi-layer thin films.

To improve the efficiency of CdTe solar cells, new fabrication techniques, grain size increases, different back contact materials are used, and the thickness of the window layer is reduced.The utility of a few buffer layers is described in this paper. Other materials with a large bandgap can be employed as a buffer layer to enhance solar cell efficiency.

Cadmium Sulphide (CdS) and Cadmium Telluride (CdTe) thin films are very useful in Solar cell applications besides other applications in transparent electrodes, photovoltaic devices, photodiodes, phototransistors, liquid crystal displays, IR detectors, antireflection coatings, etc.

Metal decorated as well as CdS or CdTe/metal oxide Nanocomposite towards the enhancement of the electrical and optical properties performance will be analyzed.

To study the conductivity of investigated materials under a wide range of base pressure, RF power, deposition time. To check the optical and electronic studies of all the investigated compositions.

Investigation of promising compositions in both oxidizing and reducing atmosphere for stability analysis.

Synthesis approaches may be altered to obtain the best performance of the material.

The influence of metal ions doping on the materials is analyzed and its conduction mechanism is discussed. Development of materials for faster optoelectronic switching devices, photodetector.