8 CONCLUSIONS AND SCOPE OF FURTHER WORK

Thin films of highly transparent conducting cadmium oxide have been prepared by spray pyrolysis and DC reactive magnetron sputtering techniques. Structure, composition, optical, electrical and laser damage properties have been studied. The salient features of the work are summarized below.

1. Structural analysis by XRD technique reveals that the films are polycrystalline in nature. In sprayed CdO films, both (111) and (200) preferential orientations are observed whereas in the case of sputtered CdO, the orientation is along the (111) diffracted plane. The structural parameters such as the lattice parameter, crystallite size, dislocation density, strain, stacking fault probability and void concentration have also been evaluated and their influence on other properties of the films have been discussed. The crystallinity of the films prepared by spray pyrolysis as well as sputtering increases with the increase in substrate temperature.

2. The composition of the deposited films has been analysed using Rutherford backscattering spectrometry and Auger electron spectroscopy. From the studies, it is concluded that the films are free from foreign impurities. Also, the results clearly indicate that sprayed CdO films contain more cadmium than sputtered CdO thin films. AES measurements carried out on sputtered samples show that the percentage of Cd and O are nearly equal among all samples. The excess cadmium atoms and the oxygen vacancies are responsible for the higher conductivity of the CdO films.

3. Optical measurements show that the films prepared by sputtering technique exhibit high transmittance than the films prepared by spray technique. Furthermore, high value of bandgap values of about 2.7 eV is reported for the sputtered CdO films owing to their high transmittance and the shift in absorption edge towards the lower wavelength region. This large bandgap suggests their use as a window layer in solar cells. The refractive index and the bandgap evaluated in the present work are in good agreement with the other reports. Both direct
as well as indirect transitions are observed.

4. Annealing has its own effect enhancing the electrical conductivity of the sputtered CdO films. As-deposited sputtered CdO films have high sheet resistance. Annealing in air at 400 °C reduces the sheet resistance appreciably. Since films obtained by spray pyrolysis are prepared at very high substrate temperatures, annealing has produced a slight improvement in the electrical properties of sprayed CdO films. Hall and resistivity measurements indicate that the electrical conductivity of the CdO films increases as a function of substrate temperature. In sprayed CdO films, similar behaviour is observed with an increase in deposition timings. High values of resistivity, carrier concentration and mobility are observed for the sputtered cadmium oxide thin films. From a comparison between the crystallite size and mean free path values, it is concluded that the ionised impurity scattering is the dominant scattering mechanism limiting the carrier mobility in the CdO films.

5. Laser induced damage studies have been carried out onto the films and it is observed that the films exhibit high damage threshold similar to other transparent conducting oxide thin films.

The CdO thin films have been successfully formed by spray pyrolysis and DC reactive magnetron sputtering. The present investigation has clearly shown that the films prepared by sputtering technique exhibit high transmittance and significant electrical conductivity. These films could be used to make optoelectronic and other solid state electronic devices such as solar cells, transparent electrical heaters, phototransistors, photocells, photodiodes, transparent electrodes and gas sensors. Also, the films had however a yellow appearance and this problem can be sorted out by adding appropriate dopants like tin and indium.