An systematic study of the oxidation of bismuth films in different atmosphere, like air, super-heated steam, nitrogen, and partial vacuum has been undertaken. The temperature of oxidation is varied from 500 K to 650 K. X-ray diffraction studies have been made of the different films prepared and the different single phase films of Bi$_2$O$_3$ (tetragonal), Bi$_2$O$_3$ (monoclinic), and Bi$_2$O$_3$ (cubic) obtained have been confirmed.

Three temperature method was also used here for the preparation of Bi$_2$O$_3$ films. Here bismuth is evaporated into an oxygen atmosphere. The impinging rate of bismuth atoms into the substrate surface is varied from $3.5 \times 10^{10}$ to $5.6 \times 10^{10}$ atoms cm$^{-2}$ s$^{-1}$. The substrate temperature is also varied from room temperature to higher temperatures. Only Bi-phase films are obtained by this technique.

Films of Bi$_2$O$_3$ obtained by three temperature method is of poor quality due to the incorporation of unreacted bismuth in the growing film. Good quality films have been obtained using activated reactive evaporation. As evidence by the x-ray diffraction studies it is seen that at constant oxygen pressure, for low bismuth evaporation rate, Bi$_2$O$_3$ and at high evaporation rate Bi$_2$O$_3$ are obtained. Refractive index, absorption coefficient, and band gap of these films have been determined from the study of optical properties.

Heat mirrors using layers of Bi$_2$O$_3$ and gold has been fabricated. Visible transmission and IR reflection have been optimized by varying the thickness of Bi$_2$O$_3$ and gold layers. These structures can be used incandescent lamps, where it will increase the efficiency and in glass panes and windows of buildings where it will give better insulation.


The work presented in the thesis comprises of the preparation and properties of certain plasma-polymerized thin films and electron beam gun evaporated V$_2$O$_5$ thin films. Plasma polymerization has been carried out both in R.F. and D.C. glow discharges. In the R.F. plasma monomer Citral was polymerized and the electrical and dielectric properties were investigated. A D.C. discharge plasma was employed to polymerize thiophene. With the intention of comparing the polymer dielectric film with an oxid dielectric film, A 5000Å thick polymer film was found to withstand more than 1000 volts without any sign of breakdown. For polycitralt films the electrical conductivity, dielectric loss, temperature coefficient of dielectric constant and percentage variation of dielectric constant with frequency were also found to be low. The observed dielectric properties were found to be comparable to those of the best known insulators. These offer the possibilities for applying polycitralt thin film as the insulating material in high voltage thin film capacitors.

V$_2$O$_5$ thin films were prepared by the electron beam gun evaporation method and their dielectric properties investigated. The films obtained by polymerizing Citral in the R.F. plasma, showed exceptionally high voltage stability and excellent thermal and chemical stability. A 5000Å thick polymeric film was found to withstand more than 1000 volts without any sign of breakdown. For polycitralt films the electrical conductivity, dielectric loss, temperature coefficient of dielectric constant and percentage variation of dielectric constant with frequency were also found to be low. The observed dielectric properties were found to be comparable to those of the best known insulators. These offer the possibilities for applying polycitralt thin film as the insulating material in high voltage thin film capacitors.

The electrical conductivity and dielectric properties of the films were investigated.
The d.c. electrical conduction mechanism was explained on the basis of ionic motion due to oxygen vacancies in the film structure. Compared to polycrystalline films, thermal stability and dielectric strength were found to be lower for V2O5 films. But the value of the dielectric constant was four times higher than that for polycrystalline films. Loss value was also higher for V2O5 films due to the presence of dipoles arising from defects and vacancies in the film material.

The interesting outcome of the investigations on V2O5 thin films was the observation of switching and memory effects in A1-V1-A1 sandwich devices. A change over from the OFF state (low impedance state) to the ON state (high impedance state) was observed when the voltage applied to the devices exceeded a threshold value. The devices could be switched back from the ON state to the OFF state by the application of suitable pulse voltages. The details of the investigations on the memory switching effects of V2O5 films are included in the thesis as an Appendix.

The polymer films obtained by carefully polymerizing the monomer thiophene in a DC discharge plasma showed conductivity in the semiconducting range. The absorption spectra of the polymer films were investigated in the UV-Visible and IR regions. The refractive index, absorption coefficient and optical band gap were determined. A possible mechanism of polymerization and a probable structure for the polymer were arrived at on the basis of IR investigations.

Photoconductivity studies on polystyrene films were carried out over a wide range of wavelengths. The results indicated the prospects of using polystyrene as a promising organic photovoltaic material. The opto-electronic measurements carried out include the variation of photoconductivity with temperature of the film as well as wavelength and intensity of illumination.

It was found that by varying the polymerization conditions the bandgap of the undoped polymer could be varied over a wide range. This shows the prospects for many interesting future results and a variety of new applications.


IV-VI compounds such as sulphides, selenides and tellurides of lead and tin and their alloys have attracted much attention for a long time. Suitably prepared polycrystalline films of lead salts have been used as photoconductive detectors in the near infrared. More recently solid solutions of SnTe in PbTe, and SnSe in PbSe have been used to construct photoconductive and photovoltaic detectors for longer wavelengths. The construction of p-n junction injection lasers of lead salts, and of solid solutions with their tin analogs has been an important technological development.

The work reported in this thesis is the preparation and the structural, electrical and optical properties of reactively evaporated lead sulphide and tin telluride thin films. The three temperature method had been used for the preparation of these semi conductor thin films. In this preparation technique constituent elements are evaporated from separate sources with the substrate kept at a particular temperature. When one of the constituent element is a gas near room temperature, the method is often called reactive evaporation. It has been found for many materials that a stoichiometric interval exists with a limited range of flux and substrate temperature. Usually this is the case for films of high melting point compound evaporation. Tin telluride and lead sulphide are typical examples, but not all compounds, nor do they decompose on melting, show the possibility of changing the ratio of the elements over a wide range and studying its effect.

A variety of physical and chemical investigations have been made for the deposition of thin films of lead sulphide. The investigations on PbS thin films by the conventional, polycrystal and polystyrene films showed conductivity in the semiconducting range. The absorption spectra of the polymer films were investigated in the UV-Visible and IR regions. The refractive index, absorption coefficient and optical band gap were determined. A possible mechanism of polymerization and a probable structure for the polymer were arrived at on the basis of IR investigations.

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