

CHAPTER IX

SUMMARY

From the results and discussions presented in the previous chapters, the following conclusions have been arrived :

XRD studies reveal that the casting Polyaniline-EB(Pani-EB) and Polypyrrole (PPY)/Polyaniline-EB films are amorphous in nature. Acid doped Polyaniline(acid Pani)and PPY films are found to have crystalline structure.

The studies on the dielectric properties have been carried out at different frequencies and temperatures with a view to study their effects on capacitance, dielectric constant and dielectric loss.

Among the different polymer films studied, polypyrrole/polyaniline-EB (PPY/Pani-EB) blend films possess stable capacitance values at all the frequency ranges studied and at temperatures upto 350 K. Also, the dielectric loss values of PPY/Pani-EB blend films are very low and independent of frequency and temperatures upto 350 K throughout the frequency range studied. In addition, the PPY/Pani-EB blend films have constant dielectric permittivity values for a moderate frequency and temperature ranges. From these observations it can be concluded that PPY/Pani-EB blend films are the suitable candidate for thin film capacitors (having capacitance in the nano/pico farad range) at lower temperature

ranges. All the polymer films of the present study possess a very low value of linear expansion coefficient (α).

The a.c electrical conduction study shows that the PPY and acid doped heavily doped Pani films are having high conductivity than the other films. It is found that $\sigma_{a.c}$ is proportional to ω^n where n varies from from 0.5 to 0.8 with the increase of temperature. DC conduction studies reveal that Poole-Frenkel type of conduction mechanism is predominant in Pani-EB and acid doped Pani films. The activation energy values of the films are evaluated.

Four probe studies indicate that polypyrrole (PPY) and acid pani films have high conductivity even at room temperature. For PPY film of thickness $0.1\mu\text{m}$, the conductivity is found to be 200 S/cm. Acid Pani of thickness $12\mu\text{m}$ shows a conductivity of 2 S/cm. Hall studies show that the carrier concentration of PPY is higher than that of all the other polymers studied in the present work. PPY and acid Pani have p-type of charge carriers while Pani-EB has both p and n-type of charge carriers.

The TEP studies indicate that the TEP values of the polymer films increase with the increase of both temperature and thickness. The low TEP values observed for PPY films certify the metallic behaviour of these films.

The thermally stimulated discharge current and pyroelectric studies of Pani-EB and acid doped Pani films reveal small peaks in the temperature range studied. The position of the peaks obtained vary only slightly with

the polarising field. The activation energies also show only a slight variation with the polarising field. These factors support the dipolar orientation theory. The peaks observed at higher temperatures are more intense than the peaks at low temperatures.

Laser damage studies on these films show that Pani films are having higher threshold energy density than other polymer films. For acid Pani films of thicknesses ranging from $3\mu\text{m}$ to $30\mu\text{m}$ the threshold energy density varies from 120 to 220 mJ cm^{-2} .

Using the above said conducting polymer films, sensor and Schottky diode have been fabricated. The behaviour of these sensors on the exposure to acetone and methanol atmosphere is studied. From the observations, it is seen that the sensing behaviour of polyaniline-EB and polypyrrole films are good with a quick recovery for acetone and methanol gases respectively. In the case of Schottky barrier diode, it is found that the junction characteristics is mainly controlled by the carrier concentrations.

The application oriented study of these polymer materials prove that these materials possess high potentiality to find suitable place in many electronic gadgets, gas sensors and thermal detectors. The electronic gadgets include thin film transistors, diodes and capacitors. It is believed that the data presented in this thesis, along with the other data available in the literatures, will be very much useful for the exploitation of these films in a variety of applications.