S.p.32. JAYALEKSHMI, S. – An Investigation on the Electrical and Optical Properties of Certain Plasma Polymerized thin Films and Evaporated V_2O_5 Films–1987–Dr. M.G. Krishna Pillai.

The work presented in the thesis comprises of the preparation and properties of certain plasmapolymerized thin films and electron beam gun evaporated V_2O_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, V_2O_5 thin films were prepared by 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 5000°A thick polymer film was found to withstand more than 1000 volts without any sign of breakdown. For polycitral 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 polycitral thin film as the insulating material in high voltage thin film capacitors.

V_2O_5 thin films were prepared by the electron beam gun evaporation technique. The electrical conductivity and dielectrical 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 polycitral films thermal stability and dielectric strength were found to be lower for V_2O_5 films. But the value of the dielectric constant was four times higher than that for polycitral films. Loss value was also higher for V_2O_5 films due to the presence of dipoles arising from defects and vacancies in the film material.

The interesting outcome of the investigations on V_2O_5 thin films was the observation of switching and memory effects in A1-V_2O_5-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 V_2O_5 films are included in the thesis as an Appendix.

The polymer films obtained by carefully polymerizing the monomer thiophene in a D.C. 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 polythiophene films were carried out over a wide range of wavelengths. The results indicated the prospects of using polythiophene 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 intersting future results and a variety of new applications.