ELECTRICAL AND OPTICAL PROPERTIES OF HETEROCYCLIC POLYMERS AND THEIR APPLICATION AS OPTO-ELECTRONICS DEVICES

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Various heterocyclic polymers like polythiophene, polypyrolle, polyfuran etc., are synthesized by the electro-chemical method from the corresponding heterocyclic monomer molecules in the appropriate electrolyte. These polymers are easily doped with appropriate anion like BF_4^-, ClO_4^-, AsF_5^- etc., or cations and also undoped electrochemically.

The fundamental electrical and optical properties like electrical conductivity, photoconductivity, magnetoresistance, optical absorption and reflection spectrum and their temperature dependences, are studied in detail. Under the doped state, the electrical conductivity of these films is in the metallic range as high as 10^2S/cm and the conductivity of undoped films is in the insulating region lower than 10^{-8} S/cm. The activation energy of electrical conductivity of undoped polymer is much smaller than that of undoped polymers. The activation energy of undoped polymer increases at high temperatures, indicating intrinsic carrier excitation of the semiconductive state.

Accompanying with this metal-insulator transition, the transmission and reflection spectra also changes remarkably. Namely colour of semiconductive state corresponding to the intrinsic excitation, changes into the metallic colour by acceptor of donor dopings and it reverses by undoping.

It is also discussed whether the spectrum of doped state can be simple explained by the plasma reflectance by free cariers or some other states like overlap of soliton band must to be taken into consideration.

This spectral change of conducting polymers by doping and undoping can be used as various opto-electronics devices. The detailed procedure of the preparation of such devices and their characteristics , for example, as optical switching element, colour switching element and optical memory switching element are discussed. The switching speed and stability of these devices are also reported in detail.

Various other possible applications of heterocyclic polymers like a rechargeable battery are also discussed.