Title: Nonlinear charge transport and photo-physical studies in conjugated polymers (P3MeT, P3HT) and their hybrid composites with silver sulfide quantum dots.

Name: Motiur Rahman Khan

SR No: 01-03-03-10-11-11-1-08877

Supervisors: Prof. K.S.R. Koteswara Rao, Prof. Reghu Menon

Department of Physics

IISc Bangalore-560012

Abstract

Organic semiconductors have been investigated as an emerging class of materials for their viable applications in electronics. Despite considerable improvement in device properties, a better understanding of the nature of charge transport in these devices and the physics of contacts is crucial to further development of organic devices. The main motivation of this thesis is derived from the fact that physics of disordered systems like conjugated polymer has yet not achieved as concrete understanding as ordered and crystalline systems such as inorganic semiconductors. This thesis investigates the transport properties of electropolymerized thin films by varying the synthesis conditions, carrier density and disorder. Several efforts have been made to understand the non-linear transport phenomena in conjugated polymers. We have also studied the charge transport, charge transfer and photo-physical studies in polymer nanocomposites with inorganic quantum dots. Temperature dependent current-voltage measurements, conductivity and impedance spectroscopy were used to investigate the charge transport mechanism in polymers and nanocomposites. We have investigated the barrier effect on the bulk limited transport in electrochemically doped polymer devies and have shown that deviation in conventional trap limited transport can be modeled by considering the barrier at interface. Effect of doping on disorder and transport show that dopant diffusing from thin films creates disorder traps in the system. We observed that the polymer synthesised at room temperature shows better transport in perpendicular direction than sample prepared at low temperature. This observation was further supported by variable range hopping parameters and Glazman-Matveev model. In the nanocomposite systems, a transition from direct tunneling to thermionic emission and then Poole-Frenkel emission was observed by increasing the quamtum dots weight percentage from 5 to 80.