

# Micro and Nano Engineering Multilayer Polymer Complexes and Opto-Electronic Systems

\*K.K.Kamani, V. Ravindrachary, ismayil, #R.K.Rangaswami

\* Physics Department, Government Science College, P.G. Center, Chitradurga – 577501

#Department of Physics, Mangalore University. Mangalore. Karnataka, India

[ [kkkamani@ymail.com](mailto:kkkamani@ymail.com) ]

**Introduction:** Polymers are widely used for this purpose because of the ease of their synthesis and the myriad of controllable properties. Polymeric material can range from insulating to conducting, from hydrophobic to hydrophilic and soft to hard. core structures Polymers are light weight, tough, Strong, Transparent, Dielectric, The use of fluorescent polymers as active materials in electroluminescence (EL) devices, optical transducers, field effect transistors is becoming a common practice. Polymer mono layer multifunctional research, monomolecular electronics aim is to combine basic functions & interconnections of a transistor to necessary data processing within a molecule The eye witness of PMMA and PVA synthetic polymers are slowly turning into biodegradable products The different polymers with variable doping concentrations can be utilized to required applications by multilayer technique to monolayer.

Demand for polymers having improved surface and bulk properties is continuously on the rise due to their use for various scientific and technological applications. In recent years irradiation with ionizing radiation like electrons, photons, x-ray and ions has also established as a tool to tune the properties of a polymer. In this case the irradiation causes cross linking, free radical formation, irreversible bond cleavages etc. within a polymer, which results in the fragmentation of molecules and formation of saturated and unsaturated groups. The latest technological trends in VLSI MOS devices have been presented.

**Electrical properties:** Conducting polymers exhibit a wide range of novel electrochemical and chemical properties that has led to their use in a diverse array of applications including sensors switch able membrane anti-corrosive coatings biosensors electro chromic devices and rechargeable batteries Polyaniline is one of the most promising candidates for industrial application of conducting polymers. It is formed via simple chemical or electrochemical oxidation of aniline dissociated metal cations contribute to DC conductivity by achieving mobility through the micro-Brownian motion of polymer segments [1-2]. Conversely, the dissociated anions move independently of the polymer motion [3]. These ion-conductive polymers have been studied extensively mainly because of their importance in industrial applications such as a polymer battery. That is why most studies to date have focused on the motion of ions [3-9]. However, this polymer electrolyte also has potential as a medium for electrochemical processes and it is important to study the local environment of the polymer within which the ions are embedded

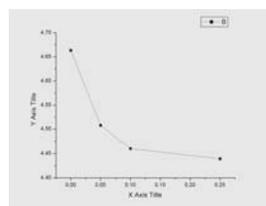
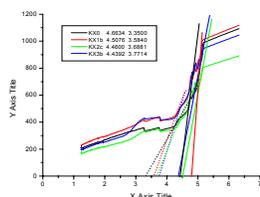
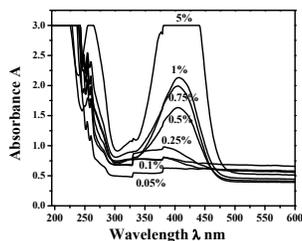
## Poly Methyl methacrylite-PMMA- $\text{CH}_2\text{CH}_3\text{CCOOCH}_3$

PMMA has received great attention due to its optical properties and its possible use in nonlinear optics. Different properties of PMMA have been studied after doping by various dopants and dielectric properties of malachite green-doped PMMA [10] and optical biostability in azobenzene-doped PMMA have been reported [11]. Franke has also studied the refractive index pattern in cosinmethylenblue-doped PMMA films [12]. PMMA is a plastic widely used for its stiffness and clarity in various industrial fields. It can be used as a good keeper for rare earth iron garnets which has wide technological application [13]. PMMA has desirable electric properties for use in structure characteristics of PMMA have been the subject of several investigations [14-16]. The aim of most of these investigations was to describe the dependence of infrared characteristics in terms of the stereo regular nature of polymer chain. Infrared spectra were used by Nagai [15] to measure the tacticity of the polymer. After doping a polymer, it is possible that a complex is formed due to the dopant molecules. The formation of a complex is reflected in the infrared spectrum of the doped polymer. PMMA is reported to be an amorphous polymer [17]. The structures of pristine and doped PMMA were investigated using analysis of their infrared spectra and wide-angle XRD analysis [18].  $\text{MnCl}_2$  was used as a flame retardant for PMMA [19]. It promotes an initial depolymerization of PMMA and thus promotes burning. A nonvolatile isomeric species is ultimately produced. Unfortunately, there is sufficient degradation [20] of the polymer to generate burnable materials, so this species is not an adequate flame retardant. The aim of the present work is to investigate the opto-electrical and the structural properties of PMMA complex.

**Experimental Techniques:** PMMA ( $\text{CH}_2\text{CH}_3\text{CCOOCH}_3$ ) was obtained from M/s. Sigma-Aldrich Inc. USA. The various dopants like Chalcone derivative dyes and Anhydrous  $\text{FeCl}_3$  was procured from M/s Loba Chemie Pvt. Ltd. Mumbai, India. PMMA films with variable wt% of required thickness samples were prepared by solution casting method. The structural and electrical properties were investigated using the following techniques. The characterization studies were carried out using Shimadzu FTIR Spectrophotometer in the range of  $400\text{--}4000\text{ cm}^{-1}$  and XRD pattern, Shimadzu UV-Visible Spectrophotometer (UV-1601) in the wavelength range  $195\text{--}700\text{ nm}$ . The virgin and electron irradiated polymer samples were subjected to spectral studies in the infrared and UV-Visible region, DC electrical Conductivity, FT-IR

studies were made to clarify the structural variations due to chalcone and other metal salts increasing wt. fractions.

**Optical properties:** These variations in the absorption peaks suggest the presence of defects such as anions, cations, radicals, organic species etc. within the polymer created by doping. Such defects may result in the formation of new energy levels within the polymer.



The variation of band gaps with  $h\nu$  (Fig 1b) shows three optical band edges, which corresponds to four optical band gaps  $E_{g1}$  (4.6634eV-3.3500eV),  $E_{g2}$  (4.5076eV-3.5840.366eV) and  $E_{g3}$  (4.4600eV-3.6881eV).  $E_{g4}$  (4.4392-3.7714). It is observed that Fig (3)  $E_{g1} - E_{g4}$  decreases exponentially with doping. The decrease in band gaps with doping concentration may be attributed to the creation of point defects that existed within the band gap by the creation of charge transfer complexes (CTC). The presence of these defects might lead to the formation of lower-energy states [21-22]. These formed CTC will create additional energy levels within the band gap and results in four band gaps. Hence the origin and variation of these optical band gaps suggests that the chalcone doping modifies the electronic structure of PMMA.

### . Micro-engineering complex structures

One of the solutions for high performance is to have a high value of oxide capacitance using higher dielectric constant (high K) materials. Another solution particularly for high speed ICs is to employ low dielectric constant (low K) Inter Layer Dielectric (ILD) materials for reduced parasitic capacitance. Strained-silicon has also emerged as an important vehicle for improving transistor performance in highly scaled devices.

**Conclusion:** The polymer PMMA with different dopants like chalcone & other metal salts such as anhydrous  $FeCl_3$ ,  $FeSO_4$  and  $BaCl_2$  forms Charge Transfer complexes (CTC.) The doping concentrations alter the electronic properties of the doped PMMA & creates defects levels. The presence of defects such as anions, cations, radicals, organic species etc. created within the polymer by doping. Such defects may result in the formation of new energy levels within the polymer. These thin polymer layers may

be used for the required applications with appreciable advantages of the semiconductor materials as well as metals and their oxides. The selection of the suitable polymer with a specific dopant concentration defines the required application. The irradiation effects also modifies structural properties of the polymer composites with shift in wavelength describes the energy conversion and storage. As Polymer composites are light in weight along with toughness, having advantage in space engineering by replacing usual materials.

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