

Study of Some Electrical Properties of poly alpha naphthyle acrylate doped with Ioden(I₂)

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Abstract

The electrical properties investigation for poly alpha naphthyle acrylate doped with Ioden (I₂) films was carried out for films prepared by cast method.

Conduction processes were analysed through measuring (Current – Voltage) and (Conductivity – temperature) relationships in the voltage and temperature ranges (1-120) V and (308 -373) K respectively.

The resistance of the doped films is found to have a negative thermal coefficient. The activation energy at temperature (308 -373)K was about (0.6)eV is found from the ohmic region of the dark (current – voltage) characteristic. The conductivity at temperature 308 was equal to 5.57×10^{-12} (S.cm⁻¹).

The deviation from ohm's law has been analysed in term of the available conduction theories, ionic conduction mechanism was concluded.

Key words: electrical properties, d.c conductivity, Ionic conduction mechanism

Introduction

The use of polymers for electronic applications is widespread and expanding rapidly [1-4]. The electrical behavior of polymers is reviewed and discussed by many authours [5-7]. The conduction mechanism of polymers is not fully understood and usually characterized as a complex process depending not only charge transfer in the bulk, but also across the polymer-metal interface at the electrode [8]. The conductivity of polymer (σ) was calculated by the following relation:[9]

$$\sigma = \frac{1}{R} \cdot \frac{d}{A} \dots\dots\dots (1)$$

Where : R is the bulk resistance of the polymer.

d is the thickness of the polymer.

A is the area of the electrode.

The activation energy (E_a) was calculated by using Arhenus equation [10]:

$$\sigma = \sigma_0 e^{-E_{a.c}/KT} \dots\dots\dots (2)$$

Where; σ_0 : constant, E_{a.c}: activation energy, T: absolute temperature and K:Boltzman constant.

The conduction mechanism type Schottky is found in many polymers such as Poly (pyromellitic-1,2

Naphthylene diamine)(PPND) [11] and Fe-doped BaTiO₃ [12].

The hopping conduction mechanism was observed in poly (phthalocyanine) (PC)[13], Amorphous Heavy – Hydrogenated silicon.[14] and (PPAB) terminated by phenylene diamine doped with Na₂[Fe(CN)₅.NO].2H₂O[15]. The Space charge limited current mechanism (SCLC) is observed in poly alpha naphthyle acrylate (PNA) doped with Lithium chloride (LiCl)[16]. Tunneling conduction mechanism is the dominant one in the very thin films such that thickness ~ 3.5nm [17].The Ionic conduction mechanism was observed in Plasticized poly(methylmethacrylate)/poly(vinylidene fluoride) [PMMA/PVdF] blend polymer electrolytes [18], LiClO₄/PEO/PCL Ternary Blends [19], single crystals of KTiOPO₄[20].and (PPAB) terminated by phenylene diamine doped with K₂Cr₂O₇[21].

In the present study the electrical properties of poly alpha naphthyle acrylate doped with Ioden (I₂) have been investigated by measuring (current – voltage) and (conductivity – temperature) characteristics. The conduction mechanism in the polymer film has been identified.