Synthesis and some physical properties of conducting polymer poly(o- toluidine) doped with dodecylbenzene sulphonic acid (POT-DBSA)

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Abstract

Poly(o-toluidine) (POT) doped with dodecylbenzene sulphonic (DBSA) was prepared by chemical methods and then dried in an oven at 50 ^{o}C for a period of 48 hrs. Powder of the doped polymer was dissolved in suitable solution in the concentration of 10 mg.ml^{-1}. These films were prepared by spin coating method on glass substrate . Thin films were then placed on a hotplate with temperature of 90°C for a period of 15 min for drying. The Fourier Transform Infrared (FTIR) spectra and ultraviolet visibility (UV- VIS. absorption) spectra, were used to characterize the structures of (POT-DBSA). The optical absorbance and transmitted are used to calculated the optical parameter and the indicated that the transition was direct transition ,with direct energy gap about 2.5 eV . Current- voltage characteristic of AL/POT-DBSA/AL is also investigated .and show ohmic behaviour .

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Keyword: poly(o- toluidine),DBSA, chemical polymerization ,optical properties.

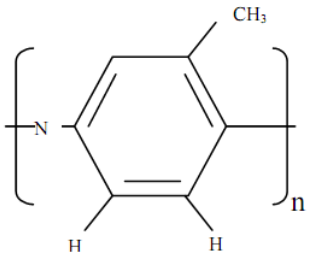
1.Introduction

Poly (O-Toluidine) (POT) and polyaniline (PANI) are considered as the most important conducting polymers [1].Conducting polymers have an immense advantage of being simple to synthesis, with their chemical structure tailored to alter their physical properties, such as their band gap. They exhibit an extensive range of electrical conductivity and can exhibit metallic to insulator property (10^{-9} - 10^{5})S/cm. Further to their ease of synthesis and with lower cost, they are known to have low poisoning effects[2,3].It has attracted great attention in the field of active materials for applications such as in organic light emitting diodes (OLEDs) [4], field-effect transistors(OFETs) [5] and solar cells [6-9].

Polyaniline (PAni) and its derivatives' are one of the most promising conducting polymers [10-13]. The most important feature that make PAni and POT so interesting as sensitive p-n junction layer for the solar cell is the variation of its electrical and optical properties at room temperature [14,15].

Poly (O- toluidine) (POT) is a PAni derivatives which contains the – CH_3 group in the ortho position of the aniline monomer as shown in fig. 1 [16], POT has been probably the most widely studied one. Indeed , Ram and Borole [17,18] as well as other authors [19] have studied the electro polymerization of (O- toluidine) using various electrolytes with different concentrations, These works revealed that POTs have interesting electro-optical properties and can be used as electrochromic and electronic devices.

In the present work , (POT- DBSA) was prepared by chemical polymerization. The polymer characterized by FTIR spectrum. Thin films of this polymer prepared by spin coating method on glass substrate for optical measurements and aluminum substrates for electrical measurement.



Fig,1 structur of POT

2.Experimental

2-1. Materials

o-toluidine) were purchased from Aldrich ,Sulfonic acid, ammonium persulfate($(NH_4)_2S_2O_8$,these chemical were used without further purification .

2-2Chemical Synthesis

Poly (o-toluidine) was synthesized by the oxidative polymerization of

(o-toluidine) in acidic media .using a method similar to the littreture [10].(0.06 mol) o-toluidine was dissolved in (500ml) distill water and (0.06 mol) selfonic acid & kept at 4c then(0.06 mol) of (NH4)2S2O8 was dissolved in (50 ml) distill water at $4C^O$ and added drop wise under constant stirring to the (o-toluidine / selfonic acide) solution over a period of (30 min) . In the end of addition The polymerization was further proceeded by stirring at room temperature for 5 h then the solution was filtered , washed successively with water ,methanol and acetone . It was dried in avaccume oven at 60CO for 12 h.

2-3Measuremen.

POT-DBSA film characterize by FT-IR . The optical properties of POT films measured by UV spectrophotometer with range (200- 900 nm) and electrical properties measured by two probe method at room temperature

3.Result and discussion

1-3 Characterization

The characterization of POT film have been curried out using FTIR analyzing technique as shown figure (2). Table (1) tabulated the wave vector of functional groups of (POT). The That Group agreement with [15,20,21]

Table (1) The functional groups of (POT -DBSA)

Functional group	**Wave number (cm-1)**	**Ref [15 ,20 , 22]**
stretching vibration of the methyl(-ch3	600-680,780	516.89,576.68,,827, 807-812, 877-882
Symmetric deformation of methyl group	1200	1210,1207-1213
C-H in SQ ring	,1000,1150,1200	1170,71150-1110,1003-10051,
C-N stretching of benzenoid ring	1480	1485.09, 1487-1492
C-N stretching of Quinoid ring	1596	1596.95, 1590, 1585-1591
C-H stretching due to substituted methyl group	2920	2923.88

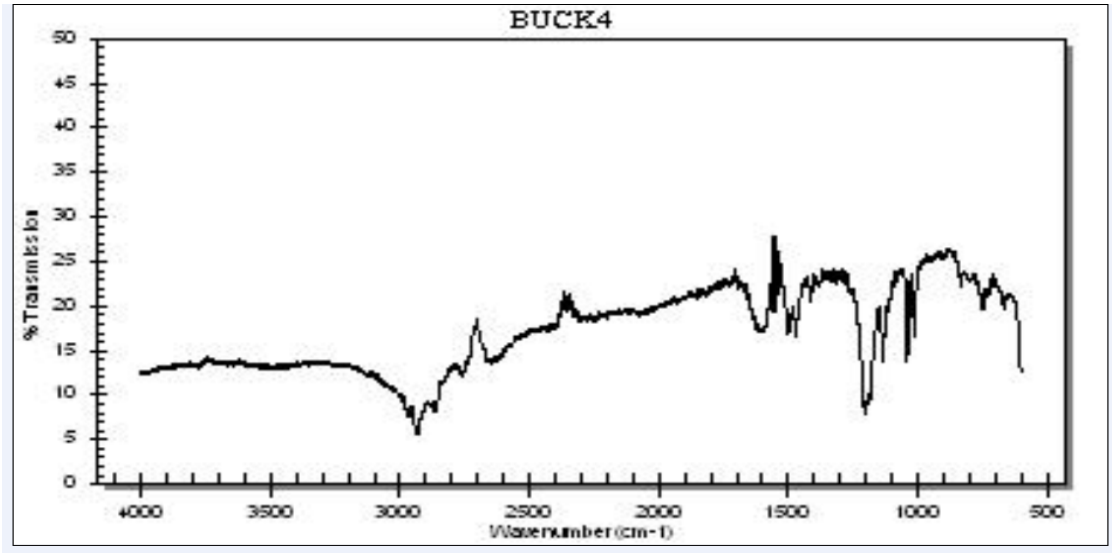


Fig.2 .FTIR spectrum of POT

3-2 Optical properties

The absorption coefficient ,α, is written as[10.22}]

$$\alpha = (\tfrac{2.303}{d})(A + \log(1-R)^2) \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where A is the absorbance (A= - logT), d the thickness of the film . The thickness of samples measured by coating thickness measurement equipment provide from oxford instruments about 2 **µ** m.

The absorption coefficient was estimated after correcting for reflection losses[10]. Fig(3) show the absorption coefficient(α) as a function of photon energy ,hν.

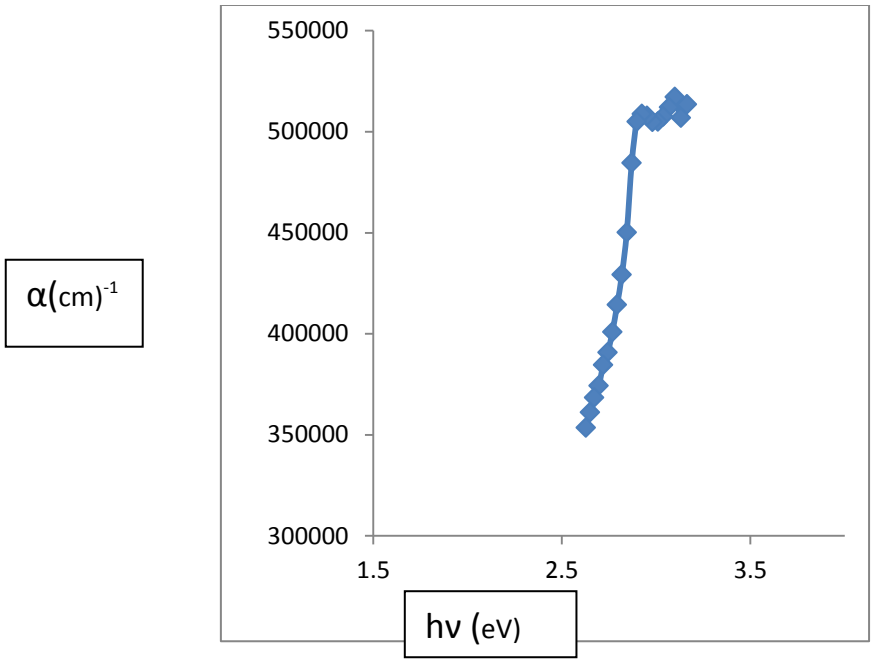


Fig 3. The absorption coefficient α as a function for photon energy of POT-DBSA

The absorption data were analyzed for evidence of inter band transition in fundamental absorption region. The data was fitted to one-electron theory of Bardeen et al [22] in order to obtained information about the direct and in direct band gap. For high absorption coefficient α > 103 that refer to direct transition[10,23].

$$\alpha = \frac{A(h\nu - Eg)^{1/2}}{h\nu} \qquad \text{----------(2)}$$

where A is constant in depended of photon energy and depending on the probability of transition and Eg direct energy gap. Fig. (4) shows the photon energy dependence on (hνα)2 of POT-DBSA . The plot of(hν α)2 agent hν yields a straight line for value of α >103 which show good fit with eq(2) , extrapolation of the straight line to α =0 gives the direct energy gap , about 2.5 eV.

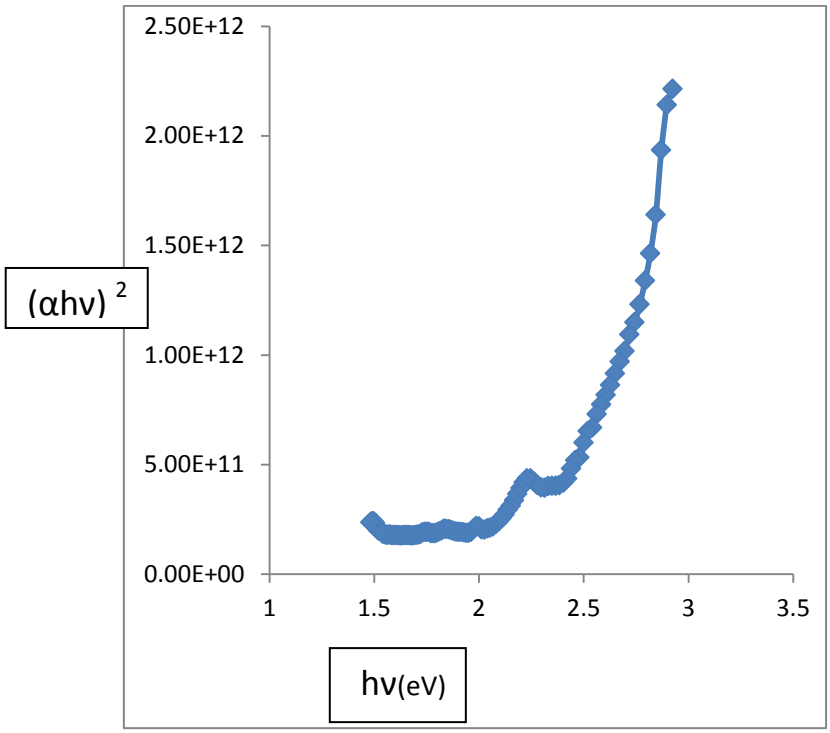


Fig .4 (αhν) 2 as a function of hν of POT-DBSA

3-3 Electrical properties

Electrical conductivity has been measured for polymers thin film by two probe method using eq.5 [10]:

$$\sigma = \frac{dI}{A0V} \quad \text{---------- (3)}$$

d is thickness of film, A0 area of section, I current pass into film, and V the voltage is applied on film.

Fig.5 show the (I-V) characterization of POT –DBSA film The conductivity found from the slop of the curve abouts 1.2*10-6 S/Cm at room temperature

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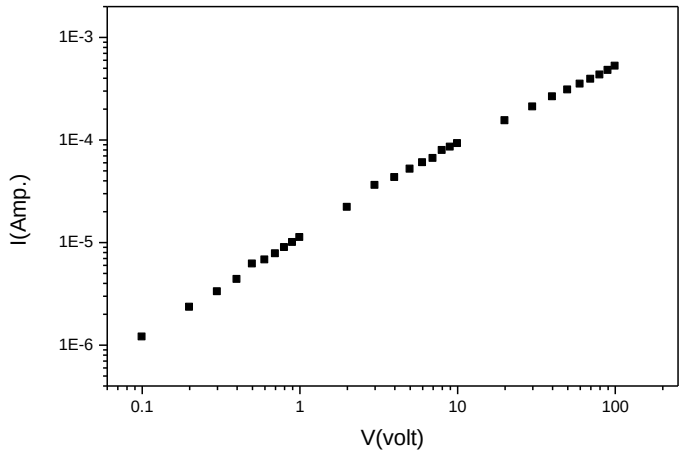

Fig.5 show the (I-V) characterization of POT –DBSA film

4.Conclusion

1) POT-DBSA could prepared by oxidation chemical method, and characterized by FTIR gave agood agreement with other outher .

2) The optical properties detect to direct energy gap about 2.5 eV .

3) The electrical properties gave electrical conductivity about$1.2*10^{-6}$ S/Cm, this indicate the polymer is organic semiconductor polymer

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الانتقالات الالكترونية للبولي اورثو تولدين المشوب بحامض السلفونيك POT-DBSA المحضرة بطريقة كيميائية

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الخلاصه

البولي اورثوتولوين POT المشوب بحامض الدوديكابنزين سلفونك DBSA حضر يطريقة كيميائية ،وبجففت في فرن 50 درجة مؤية لمدة 48 ساعة . الباودر الناتج يذوب في محلول مناسب بتركيز 10 ملي غرام لكل مول.تم تحضير اغشية رقيقة بطريقة الطلاء البرمي على صفائح من الزجاج .بعد ذلك توضع الصفائح علي صفيحة ساخنة بدرجة حرارة 90 درجة مؤوية لمدة 15 دقيقة للتجفيف. الشكل الجزيئي للاغشية تم تشخيها بواسطة مطياف الاشعة تحت الحمراء FTIR .مطياف UV استخدم في قياس الامتصاصية والنفاذية.حللت النتائج لايجاد معامل الامتصاص واذي يشير الى طاقة فحوة مباشرة حوالي 2.5 الكترون فولت.مميزة تيار-فولتية ايضا بحثت واظهرت سلوك اومي وتوصيلية كهربائية $1.2x10^{-6}$ S/cm .