STUDY THE EFFECT OF CONVENTIONAL POLYMERS TYPE ON PHYSICAL PROPERTIES OF PANI.CSA BLENDS FILMS

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Abstract- A doped polyaniline (Pani.CSA) blends films have been prepared successfully by the casting method. The Pani.CSA blends films of thickness 50 μm have been prepared from the Pani.CSA and PMMA, PS and PEO at constant concentration. The films are characterized by X-ray diffraction and Fourier transform infrared spectroscopy, the presence of characteristic bonds of Pani.CSA blends films were observed from FTIR spectroscopy technique. Electrical properties revealed that conductivity of films at room temperature are 1.03×10^{-8}, 1.48×10^{-8} and 2.35×10^{-8} S.cm^{-1} for Pani.CSA blends with PMMA , PS and PEO, respectively. Mechanical properties show variation values of tensile stress and hardness for different Pani.CSA blends films.

Keywords- Pani.CSA, Blends, conducting polymer, PMMA, PS and POE.

I. INTRODUCTION

A polymer blend or a polymer alloy as it is sometimes known, is defined as a combination of two or more polymers resulting from common processing steps mixing of two polymers in the molten state, casting from common solvent, fine power mixing, etc., these preparation methods do not usually lead to chemical bonding between the components [1].

Polyaniline (Pani) is a famous conducting polymer, has been known for more than a century in its "aniline black" form, an undesirable black deposit formed on the anode during electrolysis involving aniline. Among the conducting polymers, polyaniline is the most promising polymer due to its low cost, ease of preparation, chemical stability [2].

Polyaniline exists in three stable oxidation states that differ in chemical and physical properties; leucoemeraldine (LE), emeraldine base (EB), emeraldine salt (ES) and a fourth state , unstable, fully oxidized form known as pernigraniline [3]. Polyaniline is one of the so-called doped polymers, in which conductivity results from a process of partial oxidation or reduction. One such dopant is an organic acid called the Camphorsulfonic acid, CSA. The chemical formula of CSA ($C_{10}H_{16}O_4S$), the doping process of Pani with CSA is shown in Fig. (1). [4-5].

To improvement the mechanical properties of Pani.CSA will be blended with other conventional polymer. In this paper, we blended the Pani.CSA with different types of polymers (PMMA, PS and POE) at constant concentration and study electrical conductivity, structure and mechanical properties to find the best conventional polymer can be blend with Pani.CSA to fabrication Pani.CSA films.

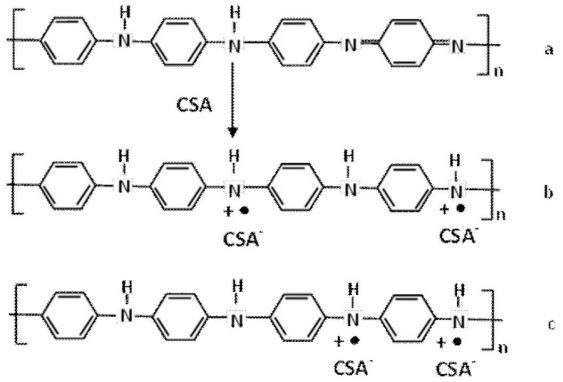


Fig. (1) (a) Insulating emeradine base form of polyaniline (b) Conducting emeradine salt form of polyaniline (Polaron structure) (c) Bipolaron structure in doped polyaniline . [4-5]

II. DETAILS EXPERIMENTAL

Casting method used to prepare Pani.CSA blends films. To prepare Pani.CSA solution, 100 mg of Pani emeraldine base was mixed with 130 mg of camphorsulfonic acid (CSA) and dissolved in 10 ml chloroform, the solution was put under stirring for 8 hours, then add 0.2 g from PMMA to 5 ml of Pani.CSA solution to preparation Pani.CSA/PMMA solution, repeat the process with 0.2 g from PS to preparation Pani.CSA/PS solution and 0.07 g from PEO to preparation Pani.CSA/PEO solution, all polymeric solution with continuous stirring for 2h in order to obtain homogenous solution. Those solutions were poured into flat glass plate dishes and dried at room temperature for 4 days. SIDCO England series FT-IR spectrometer is used to carry out the infrared analysis of the wave number that ranges 400 to 4000 cm^{-1}. Structure characterization of the prepared samples is investigated by using Philips X-ray diffraction diffractometers. For Tensile test use tensile tester type (JIANQIAO TESTING EQUIPMENT),

and for hardness test use hardness tester type Hardness (shore A) model TH200.

III. RESULTS AND DISCUSSION

Table1. shows the variation of electrical conductivity of Pani.CSA films with different blends at room temperatures. The max conductivity is found for PAni.PEO film and it was about 2.35 $\times 10^{-8}$ S.cm^{-1}, in general the high conductivity in Pani.CSA/PEO compare with other two films may be attributed to the structure state of the films, it is important to note that obtained in this work are close to those found in the literatures [6] .

The three spectrums of examination of X-ray diffraction in Figure 2. have peaks corresponding to PAni.CSA/PMMA, Pani.CSA/PS and Pani.CSA/PEO blends [7,8,9], the X-ray spectrums with many peaks were assigned to polycrystalline structure for all films blends. From Figure 2. also see the Pani.CSA/PEO and PAni.CSA/PS films have more peaks than Pani.CSA/PMMA film, which mean the Pani.CSA/PMMA film has low polycrystalline structure compare with other two films. XRD analysis show a slight variation in crystalline size has been observed as shown in Table 1. which illustrates the variation in average grain size at blends, the average crystalline size is determined by using the Scherrer formula [10]:-

$$C.S. = \frac{A\lambda}{\Delta\theta\cos\theta} \qquad (1)$$

Where A Scherrer constant, commonly assume A =1, □□□□is the full – width at half maximum of the XRD peak appearing at the diffraction angle θ. It is be found the Pani.CSA/PEO film has max average grain size.

The FTIR spectra of PAni.CSA/PMMA, Pani.CSA/PS and Pani.CSA/PEO blends are shown in Figure 3, 4 and 5, that indicates to the details of functional groups present in these blends.

The FTIR spectra of Pani.CSA/PMMA film shows in the Figure 3. from this data it is clear that peaks is corresponding to PMMA which are observed in the blended polyaniline [7]. It is noticed appearance of a peak at 3444 cm^{-1} refers N-H. the peak at 2999 cm^{-1} refer C-H aliphatic, the peak at 994 cm^{-1} refer SO_3 group, the peak at 1750 cm^{-1} refer C=O bond [11-12].

FTIR spectrum for PAni.CSA/PS film show in Figure 4. as can be seen in figure the characteristic peaks of the PAni.CSA/PS film were shown at 3036 cm^{-1} refer to C-H aromatic, the peak at 2854 cm^{-1} refer to (C-H aliphatic) , 1602 cm^{-1} refer to C=N, 1492 cm^{-1} refer to C=C, 1030 cm^{-1} refer to C-H aromatic and peak at 765 cm^{-1} refer to SO_3 group [13-14].

The FTIR spectra of PAni.CSA/PEO blend is shown in Figure 5. from this data it is clear that peaks are performed corresponding to PEO are observed in the blended PAni.CSA. The appearance of peaks along with changes in existing directly indicates the blend formation, the spectra's of PAni.CSA/PEO sample were seen as IR transmission peak at a wave number of 2881 cm^{-1}, and these refer to C-H aliphatic, 1465 cm^{-1} refer to C=N, 1340 cm^{-1} and 1261 refer to C-N, 1096 cm^{-1} and 960 cm^{-1} refer to C-H aromatic out of plan, and 800 cm^{-1} refer to SO_3 group [13-14].

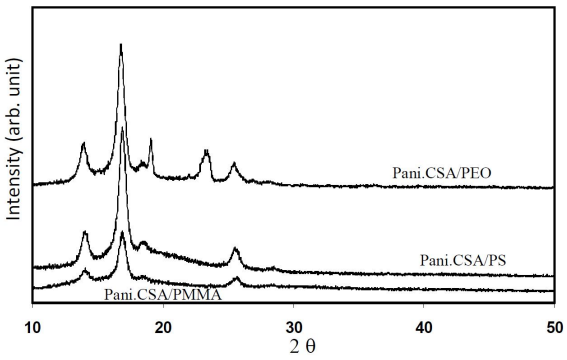


Figure 2. The XRD s pectra of Pani.CSA blends

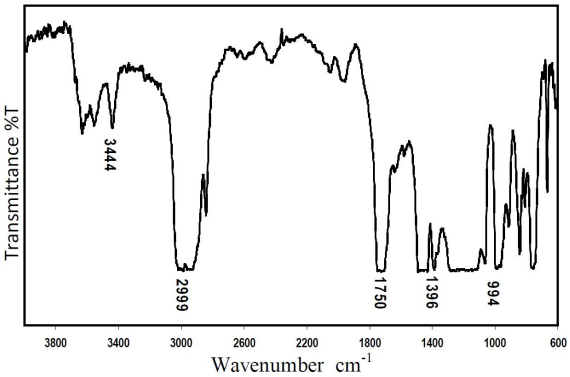


Figure 3. The FT-IR spectra of Pani.CSA/PMMA.

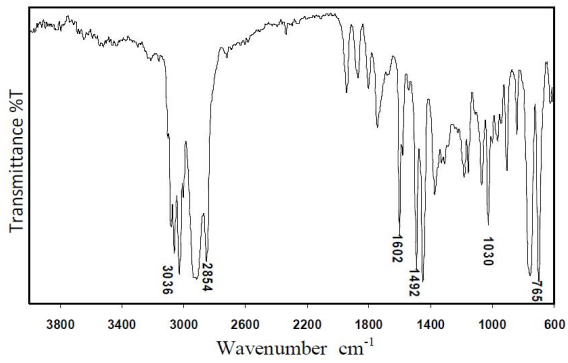


Figure 4. The FT-IR spectra of Pani.CSA/PS.

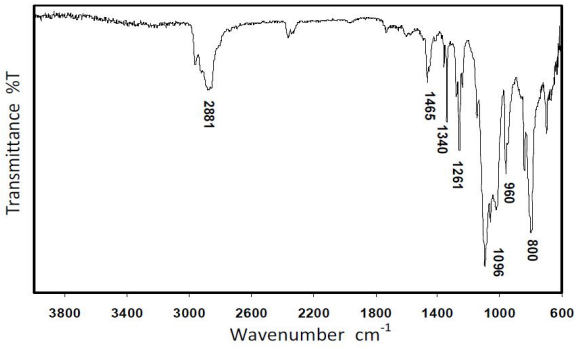


Figure 5. The FT-IR spectra of Pani.CSA/PEO.

Table 1. The electrical and structure parameters of PAni.CSA blends

Samples	σ S.cm^{-1}	C.S A°	Hardness	Tensile MPa
Pani.CSA/PMMA	1.03×10^{-8}	15.1	105.5	3.52
Pani.CSA/PS	1.48×10^{-8}	12.75	108.5	5.125
Pani.CSA/PEO	2.35×10^{-8}	12.97	103.8	5.2

Hardness means the measure of materials resistance to localized plastic deformation. Hardness tests more frequently than any other mechanical test for several reasons, it is simple and inexpensive, nondestructive, and other mechanical properties often may be estimated from hardness data, such as tensile strength. Hardness testing is carried out to determine the hardness of the Pani.CSA blends and determine the effect of add (PMMA, PS and PEO polymer) on the results. The hardness values of Pani.CSA /PMMA, Pani.CSA/PS and Pani.CSA/PEO blends are listed in Table 1.

It can be seen that the Pani.CSA/PS film has the maximum value for hardness about 108.5 , and this is may be because the high-strength reinforcements between the Pani.CSA and PEO blend, thus increasing their hardness property. While the Pani.CSA/PMMA film has minimum value of tensile as see in Table 1. that show the values of tensile strength Pani.CSA films and it can be not that the Pani.CSA/PEO film has the maximum value for tensile strength about 5.2 Mpa.

CONCLUSION

The Pani.CSA films have been successfully prepared by casting method for different Pani.CSA blends (Pani.CSA/PMMA, Pani.CSA/PS and Pani.CSA/PEO), The systematic study was conducted for structure, mechanical and electrical conductivity. The XRD show the all sample have polycrystalline structure, and FT-IR spectra revealed the incorporation of Pani.CSA blands. From D.C conductivity we found the Pain.PEO has best conductivity, the Pani.CSA/PEO has the maximum value for tensile strength. Thus we believe that Pani.CSA blends films could have potential applications, especially in flexible electronic devices.

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