MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Research Article

Received: 02/04/2022 **Accepted:**15/04/2022 **Published:** 01/09/2022

MODIFICATION OF WASTE POLYSTYRENE AND INVESTIGATION OF ITS CONDUCTIVE CHARACTERISTICS WITH THE ADDITION OF ANTHOCANDIEN PIGMENT DERIVED FROM EGGPLANT PEEL

Muhsen Chelab MUHSEN

University of Basrah, Iraq

Hikmat Abualrahim ALI[1]

University of Oil&Gas, Iraq

Fatima H. MALK[2]

University of Basrah, Iraq

Abstract:

Anthocyanin dye was produced from eggplant peels in this study, and the influence of this dye on the electrical characteristics of polystyrene polymer was investigated. The conventional casting procedure was used to create thin films. The materials employed in these films were investigated using FTIR infrared spectroscopy, and if the results showed the presence of effective aggregates within the measured region, the chance to study the feature of voltage and current using the Keithley Series 2400 Source was given. It demonstrated a rise in current with rising voltage, indicating ohmic behavior, and the electrical conductivity value is 4.7*10-12.

Key words: Eggplant, Extract Dye, Polystyrene, Current-Voltage (I-V) Characterization.

http://dx.doi.org/10.47832/2717-8234.12.34

[1] hikmatali42@gmail.com

[2] fatima.malk@uobasrah.edu.iq, https://orcid.org/0000-0003-1446-3359

1-Introduction:

The most commonly used aromatic thermoplastic polymer is polystyrene (PS). PS is used in a variety of applications, ranging from food contact packaging to thermal insulation in buildings [1,2]. Direct remanufacturing via milling, washing, drying, and moulding is the most commonly utilized recycling process[3-5]. On the other side, eggplant is one of the world's most popular veggies. On the market, there is a wide range of eggplant cultivars that vary in shape and color, with the most popular being dark purple or violet. Anthocyanins, which are found in many fruits, vegetables, and wheat, are fundamental for this color[6,7]. Asinine (delphinidin-3-p- oumaroylrutinoside-5-glucoside), discovered by Kuroda and Wada[8,9], is the most common anthocyanin found in eggplant.The eggplant, a traditional Mediterranean diet vegetable, is not only a wonderful and flexible kitchen vegetable, but it also contains a plethora of strong antioxidants. [10], making it a great ally in the prevention of major diseases such as cardiovascular disease, diabetes, and cancers. The primary phenolic chemicals are anthocyanins, which are the principal class of flavonoids that impart diverse colors to fruits, vegetables, and vegetative sections of plants[11]. Natural dyes have been revived in recent years due to rising consumer demand in natural products as they have become more concerned with quality of life and environmental protection[12]. Scientific research has revealed natural dyes' excellent properties for use in a wide range of productive activities, including the food sector, natural cosmetics, eco-fashion and organic textiles for coloring natural fibers [13]. Anthocyanins can be extracted in aqueous solution sulphited in acidified solution using their unique hydrophilicity, or using ethanol, methanol, and carbon dioxide, and there are several extraction techniques available today[14]. This research provides a waste polystyrene modification, eliminating, and researching the effect of anthocyanidin dye on the electrical properties of modified waste polystyrene..

2- Materials and Instruments:

The eggplant was purchased at a neighborhood store. All reagents and solvents were obtained from Aldrich. In addition, IR spectra were purchased by the Polymer Research Center at Basrah University in Iraq. Furthermore, the digital Keithley Series 2400 Source Meter (England) was used..

2.1- Isolation of anthocyanin's

100 g of fresh peel eggplant, cut into small pieces, was steeped for 24 hours in 200 mL of 10% acetic acid with continual agitation. Following solvent recovery, the peels were treated with 200 mL of glacial acetic acid and macerated for a further 24 hours. The peels were practically colorless after filtration, however the extraction liquid was heavily tinted in violet. The extracts were combined and dried to rotavapor at 40°C. The crude extract was first treated with 200 mL of methanol, then dried before being treated with 200 mL of distilled water until full dissolution[15]. The solution was dried and filtered.

2.2- Preparation water soluble waste polystyrene Suffocation Reaction of Polystyrene

Sulfonation Reaction was used to create water soluble waste polystyrene. The waste polystyrene dishes reacted with Sulfuric acid at 1:5 weight ratios. For 4 hours, the reaction was carried out in DCM as a solvent with a stirrer at 80C^0. Filtration at the end of the process to separate the precipitate from the mixed medium. To eliminate any leftover acid, the product was rinsed with distilled water[16]. The finished product was weighted and dried in a vacuum oven at 60 C^0.

2.3- Preparation substrates to preparing thin films for electrical measurement

There is a method for preparing the bases for the deposition of membranes prepared for electrical measurements .After cleaning and drying the glass slides, each slide was weighed, and a metal wire with a diameter of 0.15 mm was wound around it. And placed into the evaporation system to evaporate a pure aluminum membrane on it, and once the evaporation process is through .In addition, we acquired a glass slide on which a small layer of aluminum had been placed, except for Metal wire-covered areas that appeared as fissures in the membrane The materials whose electrical characteristics will be measured were then deposited.

Results and Discussion

3.1- Characterization and measurements.

FTIR spectroscopy was used to identify the chemical structures of anthocyanins.. The anthocyanins and their salt were combined using dry KBr and compacted into a pellet. These compounds were scanned in the 400-4000cm-1 range with KBr mixtures. Figures (1) and (2)demonstrate the findings of anthocyanin FTIR spectrophotometry study and polystyrene modification. As shown in Fig. 1, a broad and sharp band develops at roughly 3350cm-1 because to the stretching vibration of phenolic -OH groups. Other notable peaks in this figure are those for the phenolic hydroxyl group in plane bending and C-O stretching at 1409cm-1 and 1050cm-1, respectively. The skeletal vibrations that absorb at 1560cm-1 and 1600 cm-1 due to C=C axial deformation are distinctive peaks of aromatic carbon-carbon double bonds. The two bands found at 2920 and 2850 cm-1 correspond to symmetric and asymmetric C-H vibrations, respectively. The absorption peaks at 1050cm-1 due to the symmetric stretching vibration of phenolic -OH. The FT-IR spectra of polystyrene modification Fig. 2 revealed a peak at 3390[17-18].

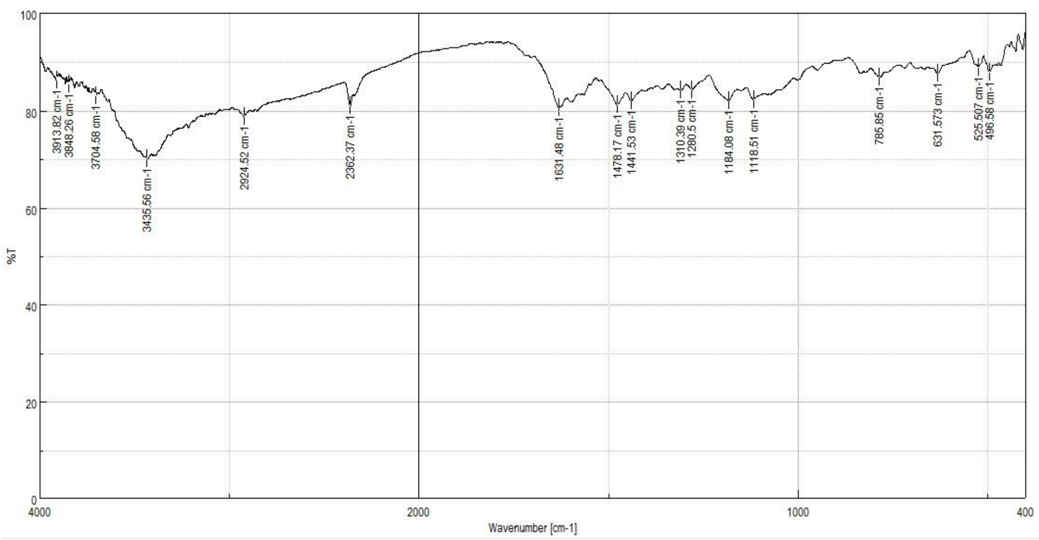

Figure 1: FT-IR of anthocyanins obtained from eggplant peel

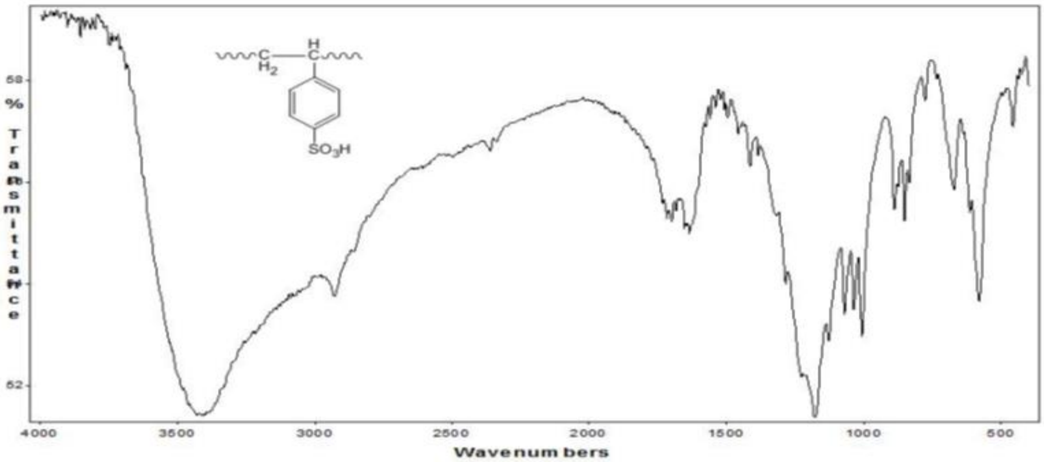

Figure 2: FT-IR of modified polystyrene

Table (1) The Important characteristics FTIR Bands and their Location of modification of polystyrene

Comp	S-OH Stre (cm^{-1})	Ar-H Stre (cm^{-1})	CH2 asy (cm^{-1})	CH2 sy (cm^{-1})	C=C Stre (cm^{-1})	C-H In plane (cm^{-1})	C-H, Out of plane (cm^{-1})	S=O Str (cm^{-1})	SO2 Str (cm^{-1})
modified polystyrene	3390	3025	1900	1830	1850	830	666	1000	1165

3.2- Electrical properties.

To analyze the conduction process in thin films, we must investigate a feature (current - voltage). Keithiey Series 2400 Source Meter, at room temperature and within the voltage range (1-12) Volt. Fig (3): (a) depicts the relationship between anthocyanidin dye voltage and current (I-V), whereas (b) depicts the link between anthocyanidin dye voltage and current (I-V) and polystyrene. The curve shows that the current values fluctuate with rising voltages, indicating Schottky conduction , but when the dye is introduced to the polymer, conduction is more regular, indicating ohmic conductance, and the material exhibits the semiconductor's behavior. A localized charge transfer condition comes from the transfer of an electron from a dye molecule to the nearest federating molecule. expresses itself (intermediate local charge transfer state), and that this state will separate, generating positive charge carriers in the dye molecule that move away from the ionized impurity particle and are not affected by the force of Coulomb attraction with it, and that these charge carriers will move away from the ionized impurity particle and are not affected by the force of Coulomb attraction with it, and that these charge carriers will move away from the Jumping will allow you to go through the organic matter, and the density of the gaps in the substance will rise as the density of the gaps in the substance diminishes. The conductivity of dye coatings rises as a result. as a result of an increase in positive charge carriers [19-20].

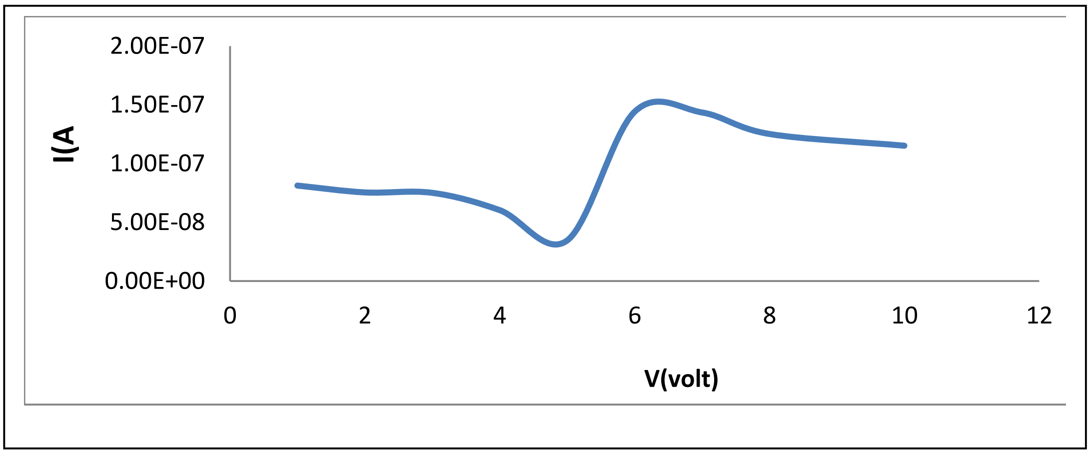

Fig (3): (a) (I-V) of anthocyanidin dye

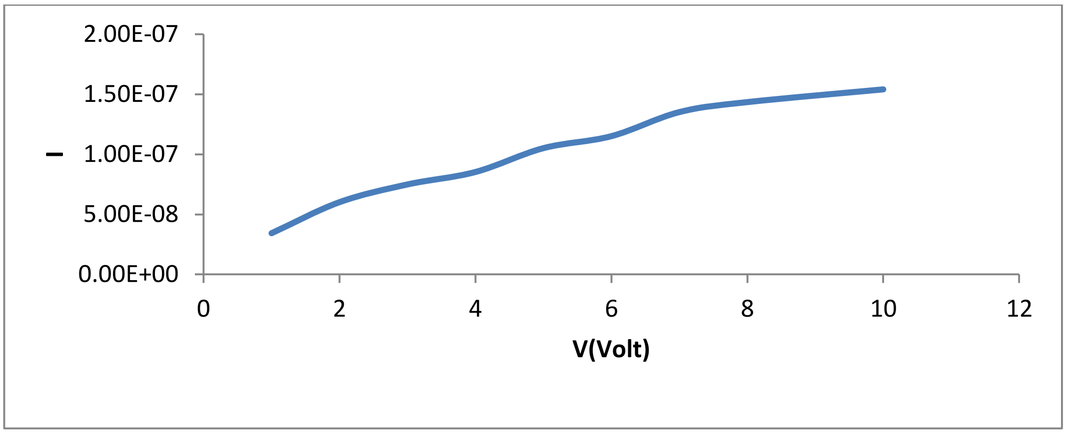

Fig (3): (b) (I-V) of anthocyanidin dye doping polystyrene.

3.3-Electrical Conductivity.

Conductivity of inorganic or organic semiconductors is usually followed [21] :

$$\sigma = \frac{I}{V} x \frac{A}{D} \dots \dots \dots (*)$$

I: - Circuit current (Ampere)

V: - Voltage circuit (Volt).

A - Area (cm).

D: - Thickness (cm).

Practically doped polymers increase electrical conductivity by increasing the amount of free electrons present, which is dependent on the conduction mechanism of the N = N group of chemicals.

Sample	Electrical Conductivity(S/cm)
anthocyanidin dye	$4.7*10^{-12}$
anthocyanidin dye doping polystyrene.	$14.5*10^{-11}$

4- Conclusion

In conclusion, anthocyanidin dye was produced and doped with polystyrene. The mixing method has been shown to be effective and successful. The effect of adding azo color to the mixture was also demonstrated. Due to the presence of materials doping, the FTIR records revealed that the bands of the effective groups were spectrally displaced and changed their behavior. Electrical properties are ultimately highly important since the desired features occur in the semiconductor.

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