FABRATION ORGANIC SOLER CELLS USED P3HT:ORANG G ACTIVE LAYERS

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Abstract

In this papers , we studies ,using dye Orang G Of Organic solar cells with P3HT as an active layer on ITO coated glass substrates were fabricated and characterized. We Using Orang G by relation with P3HT 1%,5% , and using spin coating method of the Preparation the samples. We calculated that the sample prepared with post-deposition air annealing at 120 ^{o}C improves the open circuit voltage (V_{oc}) considerably. Besides, short circuit current (I_{sc}) and the efficiency (η) layer. Series resistance (R_s) for this sample was lowest and (R_{sh}).

Keywords: Orang G , P3HT, Organic solar cells; Spin Coating.

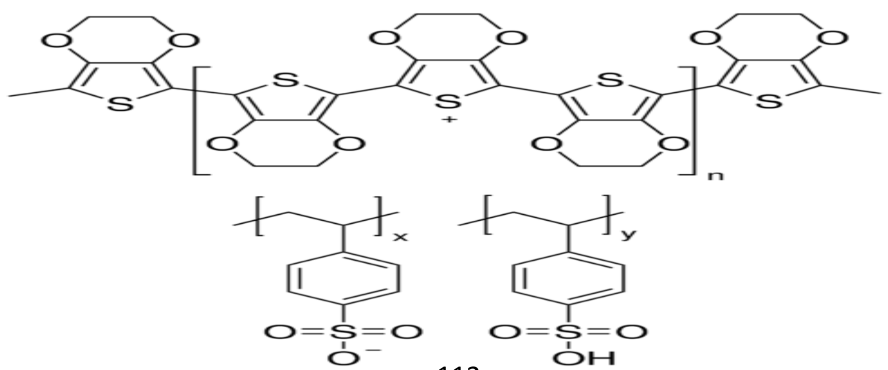
1. INTRODUCTION

With the higher consumption rate of fossil fuels, resources are about to deplete in a few decades but the demand for energy usage is continuously increasing. To meet the higher energy demands, different renewable sources are been used with more focus on solar energy because of its unbound availability. The solar energy is harvested using solar cells. The first type of solar cells manufactured were the silicon based solar cells which had an efficiency of 27% theoretically and 24% practically. The silicon based cells make use of photovoltaic effect. Such cells are also known as PV cells. There are different types of solar cells: crystalline silicon based and polycrystalline thin film and bulk and organic. With the bridging of practical and theoretical values of efficiency for silicon based cells, the demand for another type of solar cells augmented. The organic solar cells were first fabricated and demonstrated by C.W. Tang [1]. The organic solar cells with different organic compounds were fabricated and characterized in the succeeding years. So far, an efficiency of 5-6% has been achieved [2,3]. Organic materials find application in numerous electronic devices also. When used as an active element in optoelectronic devices it is called as Organic Light Emitting Diode (OLED) while with transistors as Organic Field Effect Transistors (OFET) [4,5]. An organic cell is fabricated by depositing different layers on a glass substrate. The cells can be of different types such as single layer, double layer, blend layer and laminated layer type [1]. Each of these has its own advantages and disadvantages. Different procedures are also used to fabricate a cell; for solid source, we can use vacuum evaporation technique. For liquid organic material which is the source in the current work, we use a spin coating method. Detailed studies on the preparation procedures and annealing conditions of devices are published elsewhere [7]. Here, we have used a polymer based organic solar cell. Out of many commercially available compounds, we have used PEDOT (polyethylene dioxythiophene) and PSS (poly styrene sulfonic acid) as a conducting layer over ITO (Indium tin oxide) coated glass substrate while a blend of P3HT (poly (3-hexylthiophene)) and O.G (Orang G) used as the active material. . P3HT acts as the p-type donor polymer active layer. Although, there are four different architectures- single layer, blend layer, double layer and laminated device, we have used blend layer architecture due to a large interface area if the molecular mixing occurs on a scale that allows good contact between alike molecules and most excitons to reach the Donor /Acceptor interface [8,9]. The polymer P3HT/O.G is preferred over other organic compounds because of its higher efficiency and low processing cost. The advantages of using polymer PV cells are that they offer mechanical flexibility, durability and unlimited potential from advances in organic chemistry. The performance of these cells is limited by low carrier mobility & short exciton diffusion lengths of polymers.

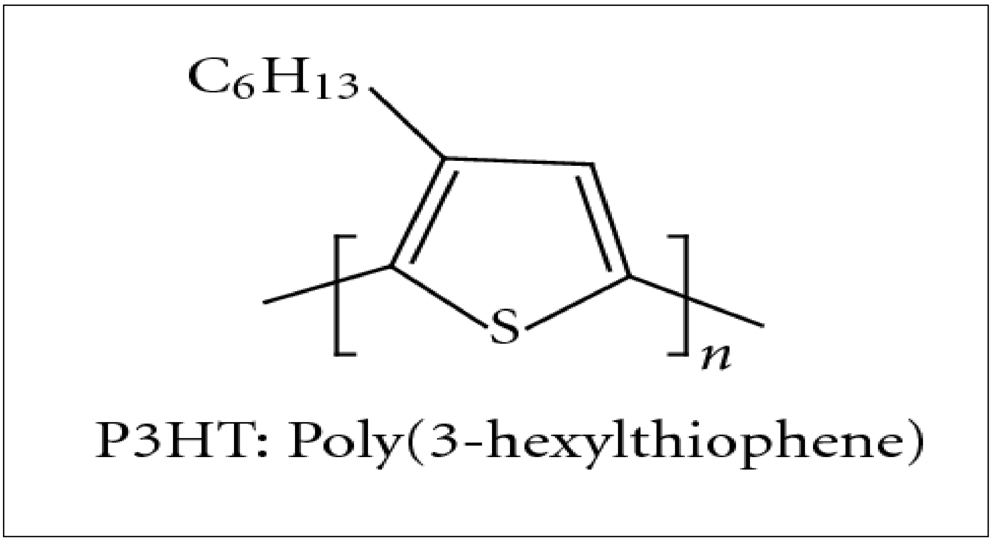
2. EXPERIMENTAL PROCEDURE

2.1 Materials Used

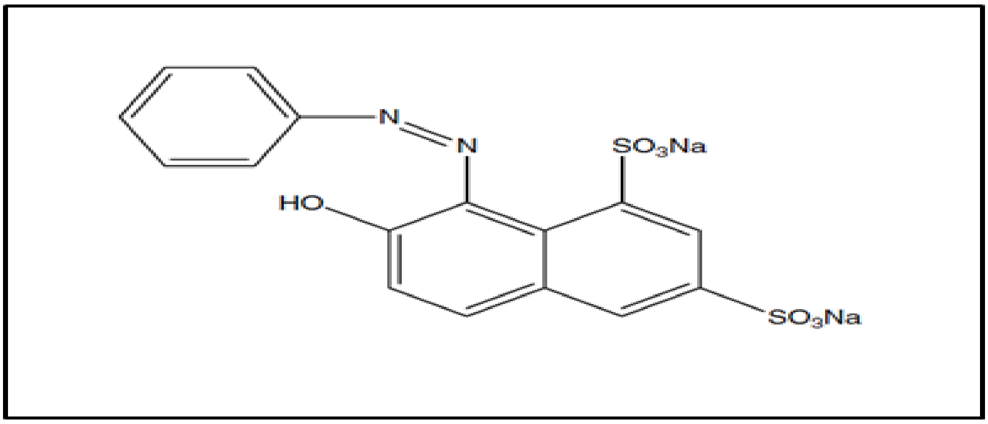
An ITO coated glass substrate has been used as the substrate for the polymer based organic solar cell. As a smoothening layer for hole transportation, PEDOT: PSS is used. The active material used is P3HT-Orang G . The active layer is a blend layer and thus is referred as blend layer architecture. The source materials of research specified above are commercially purchased from Sigma-Aldrich.



Figure(1) (a): Structure of PEDOT:PSS



. Figure(1) (b): Structure of P3HT .



Figure(1) (c): Structure of Orang G.

2.2 Preparation of the pure solution

2.2.1 Fabrication Procedure

The structure of the fabricated device is:-

Al/ P3HT / PEDOT: PSS / ITO / Glass

Al/ P3HT+ 1% Orang G / PEDOT: PSS /ITO / Glass

Al/ P3HT+ 5% Orang G / PEDOT: PSS /ITO / Glass

Indium Tin Oxide coated glass substrates were cleaned. ITO was used as the anode. Each substrate was then treated with UV light to improve the wettability of diluted PEDOT: PSS in deionized water. PEDOT: PSS was then spin coated on these substrates using Holmarc spin coater and then annealed in air for 10mints. A Polymers of P3HT was made in chloroform. A blond of P3HT in the ratio filtered using a micro-syringe. Then it was spin coated on the PEDOT: PSS layer. Final contact material aluminium was thermally evaporated in a vacuum of around 2×10^{-5} Torr through a shadow mask to form the cathode. We have prepared the devise a bove . Electrical characterization of the devices was performed using a Keithley 2400 digital source meter and a solar simulator with xenon DC . (Autosys) operating at an intensity of $1000W/cm^2$. The cell shall not be exposed much to air directly during the process of fabrication as they are degradable. Presence of dust particles or of any other foreign material is avoided by filtering the solutions.

3. RESULTS AND DISCUSSION

The UV–vis absorption spectra of P3HT: Orang G films with different ratio (1%) ans (5%) Orang G in the range from 300 nm to 800 nm, are shown in Fig. 2. It is clearly shown that the absorption spectrum of the blend becomes broad with ratio varying, which is highly desirable for a organic solar cell devices. The varying PCBM:P3HT active layer ratios films showed varying absorption intensities and locations because the P3HT had different absorption positions, and they were mixed in different ratios

Figure(3) shows the light characteristics of AL/P3HT/ : PEDOT:PSS/ ITO /Glass, AL /P3HT: (1%) Orang G / PEDOT:PSS /ITO /Glass , and AL /P3HT: (5%) Orang G /PEDOT:PSS/ITO/Glass , Organic solar cells in the. presence of light. In these figure, It can be note, the adoption of short circuit current (Isc) and the open circuit voltage (Voc) on the severity of the incident light, as with the current-voltage relationship changed accordingly. Was calculated equivalent circuit factors (Jsc, Voc, FF, η, Rs, Rsh) and all samples prepared as described in the table (1), where we note from the table to increase short circuit current and the efficiency of the cell when doping Polymer dye Orang G . when the proportion doping (5%) greater than it is in pure and tinged polymer by doping 1% due to the increased number of secondary levels between the valence and conduction scope and that contribute to the increase of electrons and gaps movement towards the poles of the anode and cathode, respectively, and thus working to increase the short-circuit current.

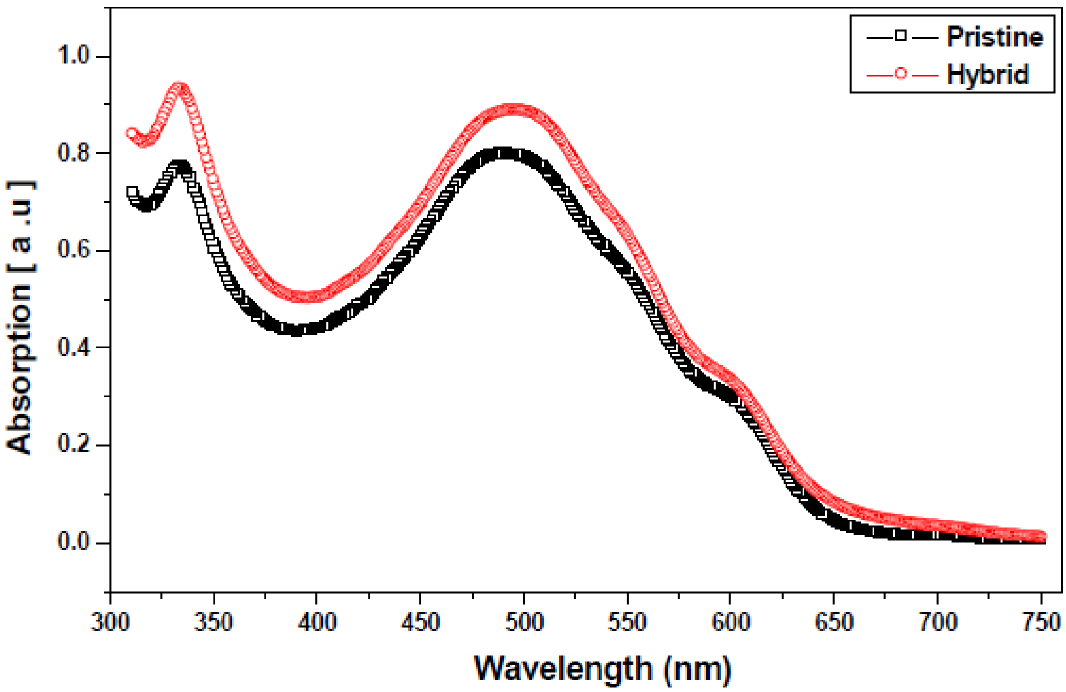
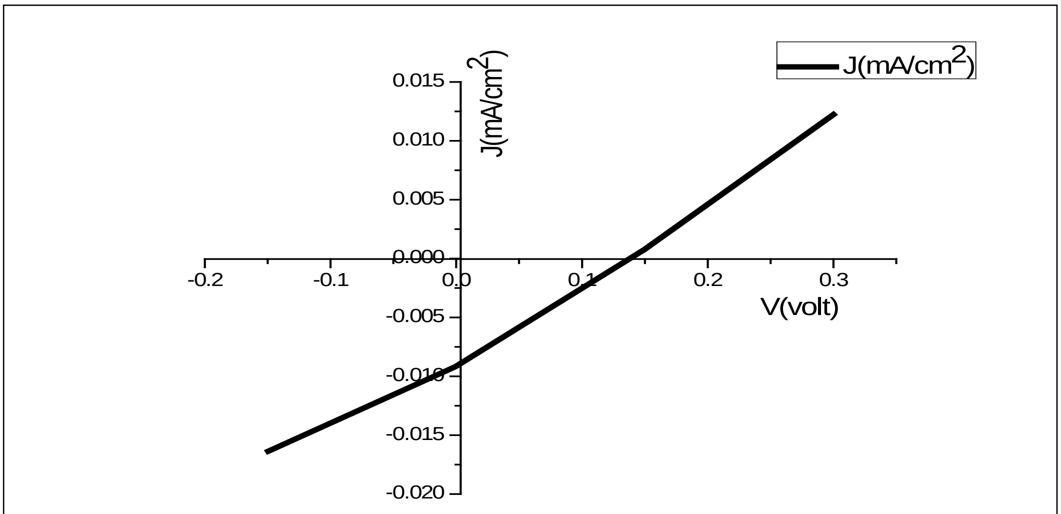


Fig.2. (a) UV–vis absorption spectra of P3HT: (1%) Orang G (b) P3HT: (5%) Orang G thin films.



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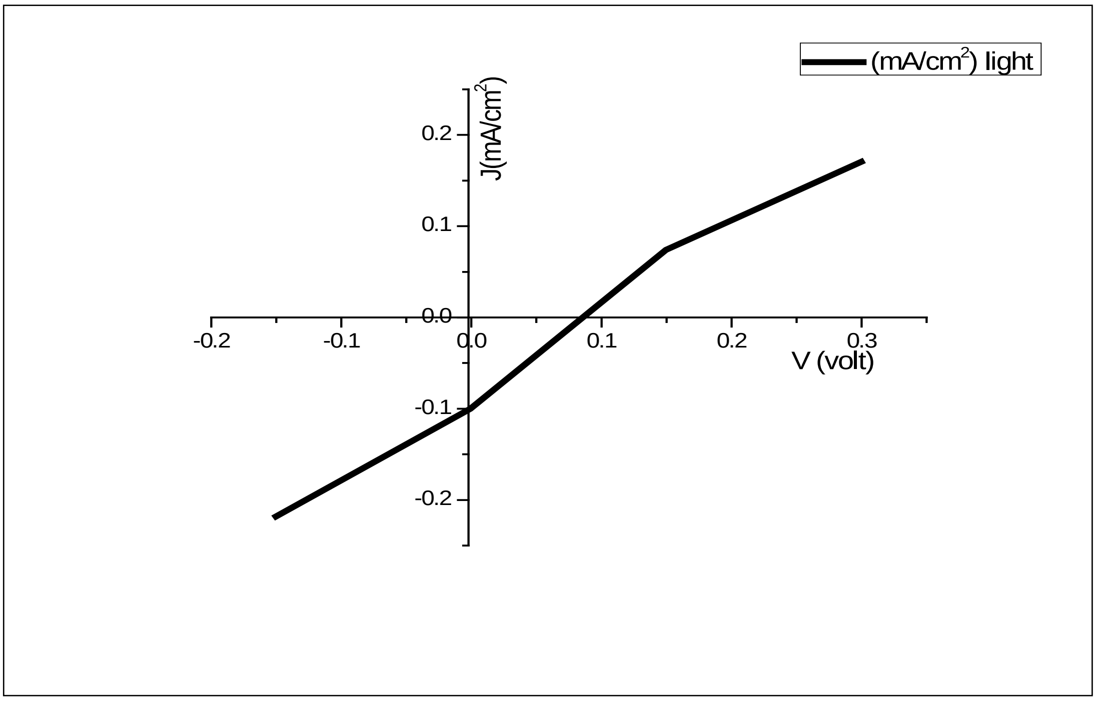

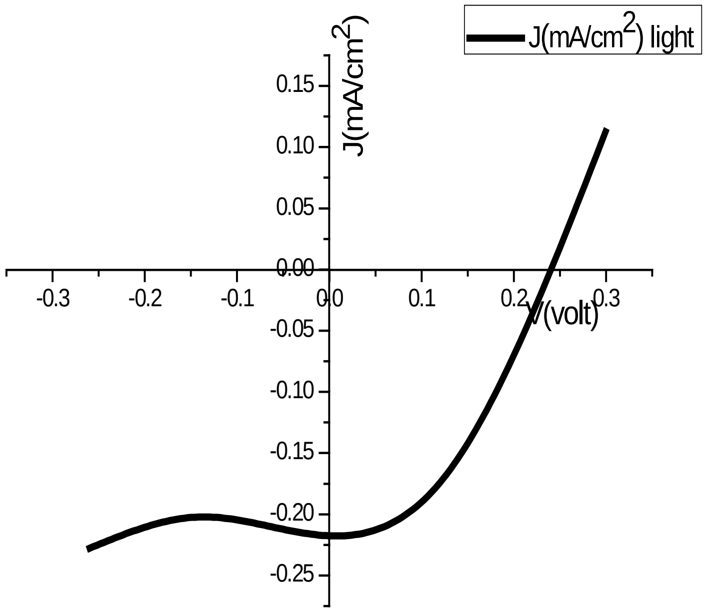

Fig.3. J–V curves of cells fabricated with (a) pristine active layer (b) P3HT: (1%) Orang G (c) P3HT: (5%) Orang G thin films.

Sample	V_{OC} (volt)	J (mA/cm^2)	FF	η %	R_{sh} ($\Omega.cm^2$)	R_s $\Omega.cm^2$
pure	**0.07**	**0.046**	**0.2**	**0.03**	**1400**	**200**
1%(O.G)	**0.09**	**0.37**	**0.22**	**0.15**	**1200**	**63**
5%(O.G)	**0.24**	**1.5**	**0.36**	**0.21**	**1100**	**60**

CONCLUSION

We fabricated the efficient P3HT:Organg G photovoltaic cells. Light absorption of increased the charge-carrier mobility in the hybrid photovoltaic cell. We anticipate that this new concept of making hybrid polymer:fullerene:inorganic photovoltaic cells will be helpful to further improve the PCE of polymer photovoltaic in near future.

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