Effect of doping on performance of Fullerene: MEH-PPV solar cells

Howida Abdalla Osman

University of Bahari,Sudan,Physics department

Abstract

Solar cells harness solar energy, which is an abundant and renewable energy resource, and convert it directly into electrical energy by the photovoltaic effect. I prepared three samples of organic photovoltaic cell devices by using polymer and fullerene MEH-PPV/C_{60} composites with different concentrations of fullerene and characterized by short- circuit current and open- circuit voltage, for polymer of weight 0.0549g with changing the concentrations of fullerene (0.304,0.302,0.300)g shows that the efficiency increases in the range with increasing concentration of fullerene C_{60} of (0.076-0.083).This means that increasing concentration of fullerene, increases efficiency due to the increase of carriers concentrations as shown by theoretical relations since they acts as a donor and a acceptor.

Key word : efficiency, photovoltaic cell, fullerene ,solar cell

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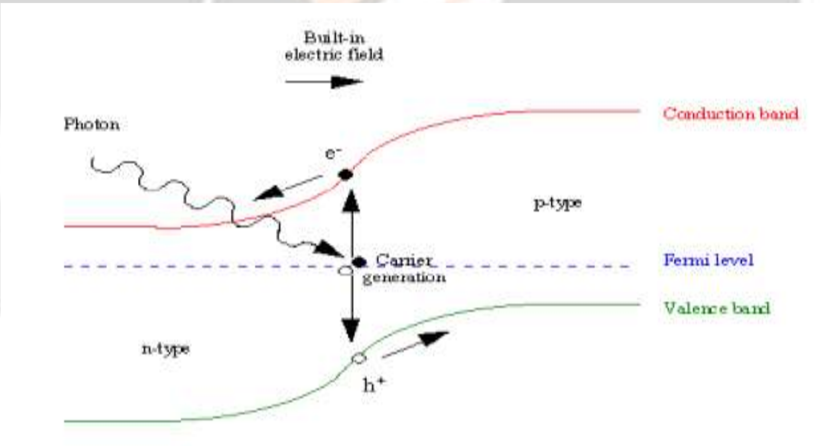
1.INTRODUCTION

Photovoltaic devices are designed to convert solar energy into electric energy. By using the right type of semiconducting materials in a photovoltaic device, it can effectively convert the energy. Semiconducting materials creates electrons and holes by absorbing incoming light Fig(1).



Fig(1) Solar cell working principle

A solar cell is a photodiode, which consists p and n type semiconductors. When these two semiconductors come together, a depletion region is formed. Electron hole pairs are generated in the device when light is incident on the solar cell. The electron hole pairs, generated near to the depletion region in the open circuit condition, tend to recombine. This phenomenon leads to reduce depletion region since it generates free carrier in some areas which becomes not belong to depletion region. This reduction is equivalent to a applying forward voltage to the device Hence, this reduction in depletion width tends to develop a voltage across the terminals of the diode [1,2]. Maximum voltage elimination of complete depletion region. This is called open circuit voltage. If the device is short circuited, all of them. Electron and hole generated will flow through the device. The current generated by the flow of photons is called short circuit current [3].

The first donor-acceptor system that we studied was poly[2-methoxy,5-(2'ethylhexyloxy)-1,4-phenylene-vinylene] MEH-PPV is widely used in the fabrication of polymer solar cell[4.5] as the electron donor material and C_{60} as the acceptor .

2.EXPERMINTAL

The main reason for choosing these materials was the high solubility of MEH-PPV in organic solvents like choloro benzene, chloroform, toluene etc. all devices in this work were fabricated on indium tin oxide (ITO)-coated glass substrates, the MEH-PPV/C_{60} was dissolved in chloroform and spin coated on the layer, with structure of ITO/MEH-PPV: C_{60} /Ag. three samples were prepared at different concentrations of fullerene C_{60}, the electrical circuit used to measure I-V curves as shown in figure (2). By varying the resistance of the potentiometer the voltage across the cell can be found. The advantage of this circuit is due to measuring the output. The intersection with the voltage axis (I = 0) is the open circuit voltage while the intersection with the current axis (V = 0) is the short circuit current fig(3,4,5). This measurement also gives us the maximum power and fill factor, table(1).

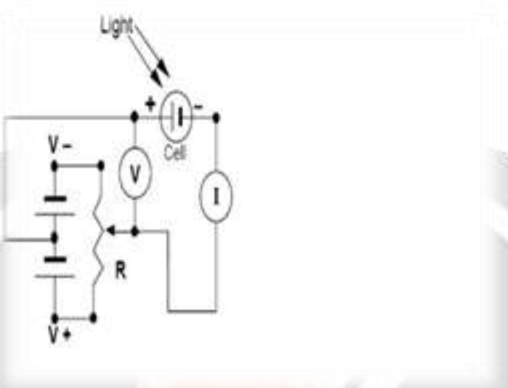


Figure 2: The circuit used to take measurements for the I-V curve[6].

3.RESULTS AND DISUCTIONS

from these graphs a few important performance parameters can be extracted, mainly the open circuit voltage, short circuit current, fill factor, and maximum power.

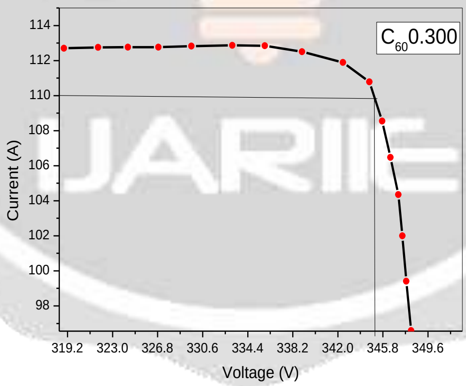


Figure (3) the I-V curves for C_{60}=0.300g with MEH-PPV =0.0549g

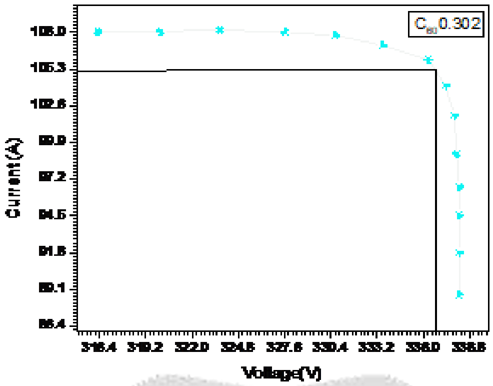


Figure (4) the I-V curves for C_{60}=0.302g with MEH-PPV =0.0549g

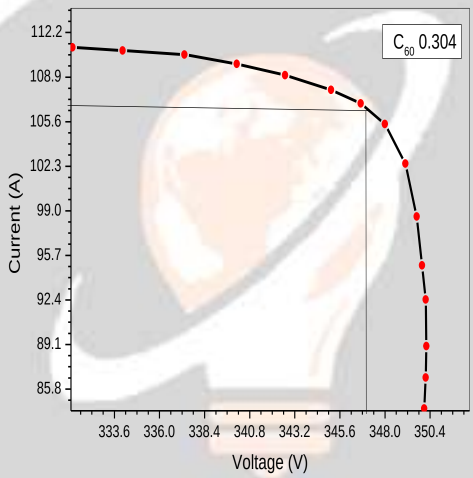


Figure (5) the I-V curves for C_{60}=0.304g with MEH-PPV =0.0549g

Table.1performance for C_{60}/MEH-PPV solar cell for different concentration of fullerene C_{60} with 0.0549g MEH-PPV

No	Sample MEH-PPV/ C_{60}	I_{sc}	I_{oc}	V_{oc}	V_{mp}	P_{max}	FF	η
1.	0.0549/0.300	11.24	11.01	0.3481	0.3450	3.7988	0.945	0.076
2.	0.0549/0.302	10.81	10.53	0.3368	0.3382	3.5630	0.970	0.080
3.	0.0549/0.304	11.12	10.66	0.3501	0.3469	3.6995	0.9781	0.083

4.CONCLUSION

The worldwide demand for energy has grown dramatically over the last century with an increase in the industrialization of the world. The need for energy is likely to grow even more in the 21st century with the improvements in living standards across the planet. In this work three sample were prepared for different concentrations of Fullerene / polymer with two silver electrodes. According to table (1) the concentration of MEH-PPV is fixed and given to be 0.0549g while the concentration of Fullerene was varied from (0.300,0.302,0.304)g. The result are displayed is in the figure (3,4,5) from which the efficiency obtained in the range of (0.076-0.083) %. This means that increasing Fullerene concentrations increases its efficiency.

5.ACKNOWLEDGMENTS

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