ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

Comparison between Solar cell and Infrared Plastic Solar Cell

Prabhat Gupta[1] Vaishali Srivastava[2] Manuj KumarVerma[3] Arvind Shukla[4]

[1]B.Tech Student, Department of Electronics and Communication Engineering, I.E.T Sitapur, Uttar Pradesh, India

[2]B.Tech Student Department of Electronics and Communication Engineering, I.E.T Sitapur, Uttar Pradesh, India

[3]Assistant Professor, Department of Electronics and Communication Engineering, I.E.T Sitapur, Uttar Pradesh, India

[4]Assistant Professor, Department of Electronics and Communication Engineering, I.E.T Sitapur, Uttar Pradesh, India

ABSTRACT*:* Along with the development of civilization is increasing energy consumption day by day .As coal, gas oil, and nuclear energy fuel prices continue to rise, a better alter native is to generate solar panels. We know that the sun is the ultimate source of energy in form of light and heat, but we are unable to use it efficiently. Solar panels are active solar devices that convert sunlight into electricity. The primary content of solar panel is solar cell. The photovoltaic cells are of high cost and low efficiency. A better alternative is to use infrared plastic solar cell which are in limelight from past few years because of its properties of providing environmental safe, flexible, light weight, inexpensive, and efficient solar cell. The biggest problem of solar cell is high cost and efficiency, but the use of plastic solar cell with nanotechnology help us to build solar cell more economical and efficient.

I. INTRODUCTION

As the pool of available resources is being exhausted, the demand for resources that are everlasting and eco- friendly is increasing day by day. One such form is the solar energy. As such solar energy is very useful. After passing through the earth's atmosphere, most of the sun's energy is in form of visible light and infrared light radiation. According to Wikipedia solar radiation reaches the earth's atmosphere with power of 1366 watts per square meter (W/m^2). Since the earth is not flat, the surface nearer its poles is angled away from the sun and receives much lesser solar energy than the surfaces near the equator. At present conventional solar panels convert only 15% of sunlight into electricity, hence the efficiency is low. Due to the construction process and materials used conventional solar panel have limited number of applications. The development of new type of solar cells named as infrared plastic solar cell created an opportunity to gain more energy from solar cells from its increased efficiency and other use full applications.

Solar Cell: - Photovoltaic effect is emergence of electric voltage in a system exposed to solar radiation. With absorption of photons, charge carriers are excited into conduction band. The mechanism of light induced electron transition to a higher energy state is similar to that of photoelectric effect, where a photon carrying sufficient amount of energy frees an electron from the surface of a metal. The photoelectric effect was explained by Albert Einstein in 1905. Converting solar radiation into electrical energy is called photovoltaic (PV). Devices exploiting PV effect are called solar cells, also photovoltaic cells or photovoltaic devices. Global electricity consumption amounts to approximately 2·1014 kWh per year. Could solar cells satisfy the world's hunger for energy and how much of the land would be needed? The Sun provides 1000 W/m2 of power density for a surface perpendicular to the Sun's rays at sea level on a clear day. The actual power at septic area varies with seasons and depends on the geographic position of the area. It must be taken into account that the Sun shines only during the day and that the angle of Sun's rays varies during the day, if the PV devices do not rotate. We also estimate, that there is 70% of sunny days in a year. With a little of calculation, we arrive at average power density of 120 W/m2 coming from the Sun, which we multiply by PV device efficiency of 10% to get the power density obtained from PV. Dividing the consumption by the power density obtained from solar cells, we get the area of solar cells needed, which is

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

approximately 1012 m2 or 0.7% of Earth's land . By making a similar calculation only for Europe, a continent with relatively high population and little sun, we find that we should cover approximately 8% of Europe land to provide the whole Europe with electricity. That is quite a lot, but fortunately, Sahara desert, with area of 9.4·1012 m2 is close enough to be exploited. After these estimates, we see that solar energy could be one of the most promising energy sources, alternative to the currently dominating fossil fuels. The problem is, however, very high cost of PV, particularly crystalline silicon solar cells, which currently have the highest known efficiency. Although there are cheaper alternatives to silicon, they lack of either efficiency or chemical stability, or can not be prepared by fast processing techniques. In principle, efficiency of solar cells is limited by the band gap of the material used, because the band gap has to match a part of solar frequency spectrum. It is also connected with impurities in the material. Cheaper materials often contain a lot of impurities, which can act as recombination centers for photo generated charge carriers, thus lowering the efficiency and stability of a cell. Chemical instability refers to light induced degradation in amorphous silicon solar cells or to the limited number of redox cycles for electrolytes in novel solar cells.

Solar Cell Structure: - We present the structure of a c-Si photovoltaic device. Crystalline silicon solar cell is composed of two basic layers, the emitter, which is n-doped, and the base, which is p-doped semiconductor silicon. The front contact has to be designed in a way that prevents shading of the front surface. Because the bulk of the electron-hole pairs is generated near the surface, the position of p-n junction is also near the surface. This prevents recombination of charge carriers before they reach the junction, where they are separated by electric field.

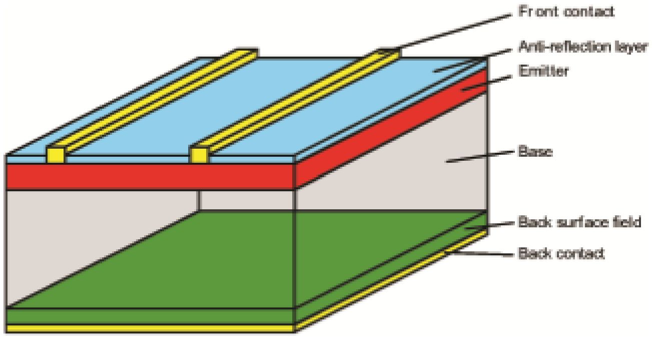
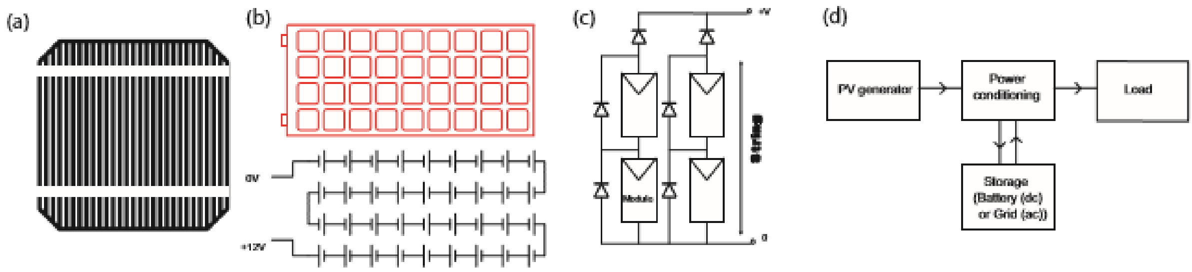


Figure 1: Structure of crystalline silicon solar cell.

Basic definition:-A single solar cell area is typically about 100 cm2, it generates a dc photovoltage of 0.5 -1 V and photocurrent of several amperes [12]. Because of low voltage and electric current, cells are connected into modules, which produce standard voltage of 12 V. Modules are further connected into strings. Due to the fluctuations in solar irradiation during the day, PV systems also include components for charge regulation and storage. Parts of PV system are illustrated in Figure 2



ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

Figure 2: (a) Solar cell with surface contacts. (b) Cells connected in a module. (c) Modules are connected in series into strings and in parallel into an array, to produce sufficient current and voltage. (d) Integration of charge regulation and storage.

Infrared plastic solar cell: the discovery of conducting plastic in 1977 by Prof ALEN HEEGER helped in fabrication of solar cell. Scientist have invented plastic solar cell that can turn solar energy in to electrical energy even on cloudy days. Plastic solar cells are not new. But existing materials are only able to absorb sun's visible light. 44% of the sun's power exists in visible region and 53% of the power exists in infrared region. The new discovered plastic compound is able to absorb infrared radiations of solar power. These plastic solar cells could become more efficient than current solar cell.

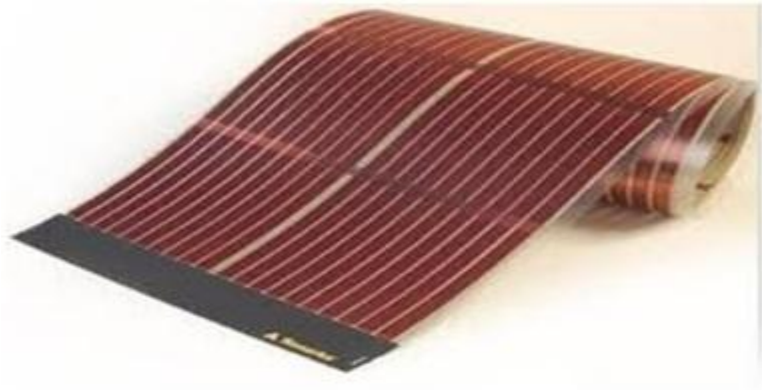


Fig 3: infrared plastic solar cell

With new plastic solar cell could allow up to 30% of suns radiation while today best plastic solar cell harness only 6% of power. Solar energy reaching the earth is 1000times than what we consume this can replace all other energy sources.

Design of plastic solar cell:-

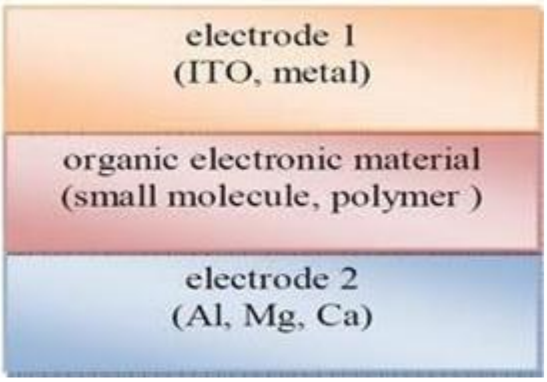


Fig.4: basic structure of plastic solar cell

Plastic solar cell is a hybrid of tiny nanorods dispersed in an organic plastic. as shown in fig 4 polymer layer is sandwiched between two electrode 1 and electrode 2.The most commonly used method in production of plastic solar cell are vacuum evaporation and solution processing technique. The technique used for deposit conjugate semiconductor semiconductor polymers are printing/coating. Spin coating, doctor balding, as well as screen printing methods are applied for plastic solar cell. Such printing/coating technique leads to large production with low energy consumption.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

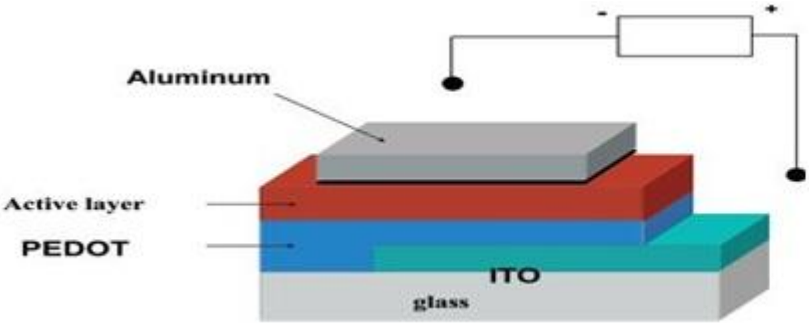


Fig.5: The active layer is sandwiched between two contacts an indium tin oxide electrode and an aluminum top electrode.

The sandwich method is used for plastic solar cell. ITO electrodes are trans parent and conductive but expensive. The substrate electrode PEDOT: PSS, poly (ethylene-dioxythiophene) can be structured by chemical etching. Solution or vacuum deposition techniques are used for coating active layer. The nanorods derived from 1-(3-methoxycarbonyl) propyl-1-phenyl-[6,6]-methanofullerene(PCBM) are mixed with plastic semiconductor called (P3HT). The function of black electrode is done by aluminum coating. The nanorods work as live wire. When the absorb infrared light, they generate electron hole pair in the crystal that moves around. The electron travels through the length of rod till it is collected but aluminum electrode. Hole travels to plastic.

II.WORKING OF PLASTIC SOLAR CELL

The 200 nm thick layer is sandwich between electrodes produce about 0.7 volts. At present time plastic solar cell can be manufactured in a solution in a beaker without vacuum chambers or clean rooms.
Figure shows the electron energy levels of P3HT/PCBM blend system.

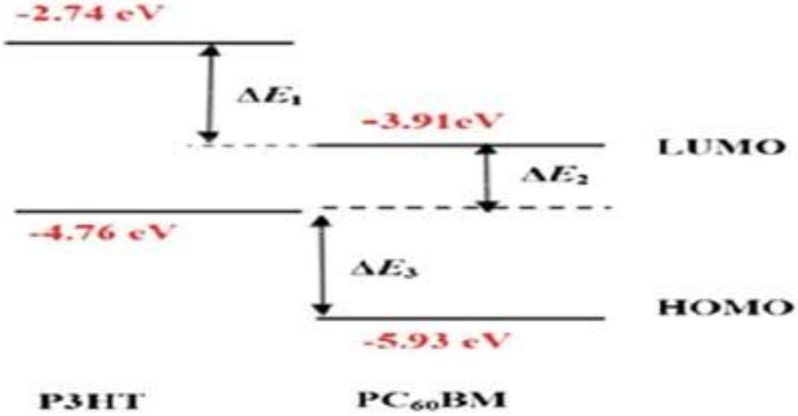


Fig.5: electronic energy level of P3HT and PC60BM

The electrons having energy band between 2.0Ev and 3.3eV can absorb by the active layer, and exactions will be formed. Active materials with broad absorption band could be used, in order to make better utilization of the sunlight. The negative charge will travel through the lowest occupied molecular orbital level of P3HT, and positive charge will travel through highest occupied orbital level of P3HT, and then the electrodes collect the charges. Photo electric conversion process consumes 70% of charge. Highest occupied molecular level and lowest occupied molecular lever of donors and acceptors should be tuned carefully to minimize the loss.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 6, Issue 3, March 2018

Technology	Com Eff (%)	Champ Eff (%)	Module ($/W)	Installed ($/W)	LCOE (cents/kWh)
Wafer Si	15	25	2	8	17
a-Si	6.5	13	1.2	4.5	21.7
c-Si	5	10	1.3	4.8	18.3
CdTe	9	16.5	1.21	4.5	19.9
CIGS	9.5	19.5	1.8	6.3	22.2
Organic PV	-	5.2	*0.70*	-	-
DSSC	8	11	1.9	-	-
Hybrid	-	6	-	-	-
Coal					5 to 8

III.CONCLUSION

The main advantage of plastic solar cell over conventional solar cell is its efficiency and wide range of applications. Plastic solar cell can fulfill all our energy needs. By further improvement in fabrication of plastic solar cell, and by using different materials we can manufacture with higher efficiency and lower cost. In future infrared plastic solar cell is of great use, and can generate sufficient amount of energy from every possible plain surfaces by painting on it.

REFERENCES

[1] Nanomaterials: Synthesis, Properties and Applications : Edelstein, A. S., Cammarata, R. C., Eds.; Institute of Physics Publishing: Bristol and Philadelphia, 1996.
[2] The Coming Era of Nanotechnology; 1987. Drexler, K. Eric, Doubleday; New York
[3] Conjugated Polymer-Based Organic Solar Cells:Serap Gunes, Helmut Neugebauer, and Niyazi Serdar Sariciftci, Chem. Rev. 2007, 107, 1324-1338
[4] Modeling the optical absorption within conjugated polymer/fullerene-based bulk-heterojunction organic solar cells: H. Hoppea, N. Arnoldb, N.S. Sariciftcia, D. Meissner, Solar Energy Materials & Solar Cells 80 (2003) 105–113.
[5] Active Layer Materials for Organic Solar Cells, Jianhui Hou and Xia Guo W. C. H. Choy (ed.), Organic Solar Cells, Green Energy and Technology, DOI: 10.1007/978-1-4471-4823-4_2, _ Springer-Verlag London 2013.
[6] Organic solar cells with carbon nanotube network electrodes,Michael W. Rowell,Mark A. Topinka, and Michael D. McGehee, applied physics letters 88, 233506 _2006.
[7] Polymer-based solar Cells: Alex C. Mayer, Shawn R. Scully, Brian E. Hardin, Michael W. Rowell, and Michael D. McGehee, NOVEMBER 2007 | VOLUME 10 | NUMBER 11, ISSN:1369 7021 © Elsevier Ltd
Shraddha R. Jogdhankar, Channappa Bhyri
Impending Power Demand and Innovative Energy Paths - ISBN: 978-93-83083-84-8 340
[8] Nanomaterials and Energy,Volume 1 Issue NME1,2011,Controlling nanomorphology in plastic solar cells, Carr, Chen, Elshobaki, Mahadevapuram and Chaudhary
[9] A gentle introduction to the next big idea-Mark A. Ratner, Daniel Ratner.
[10] 'plastic solar cells' By Christoph J. Brabec, N. Serdar Sariciftci, and Jan C. Hummelen, Adv. Funct. Mater. 2001, 11, No. 1, February
[11] Visibly Transparent Polymer Solar Cells Produced by Solution Processing, Chun-Chao Chen, Letian Dou,Rui Zhu, Choong-Heui Chung, Tze-Bin Song, Yue Bing Zheng, Steve Hawks, Gang Li, Paul S. Weiss, and Yang Yang, Published online10.1021/nn3029327, 3 july 2012