Organic Solar Cells-A Review on Revolution in the Photovoltaic Research

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Abstract- Organic Solar Cell is the third-generation technology in the field of photovoltaic and a great achievement in usage of renewable energy in such an efficient and reliable manner. This technology seeks to provide energy at a lower cost than that provided by first and second generation solar cell technologies. Although organic photovoltaic have achieved efficiencies close to 11%, performance limitations and long-term durability continue to be major barriers. It will also highlight the future research challenges. In organic solar cell there is low consumption of material per area which results in easy processing of organic semiconductor offering a huge potential for low cost large area solar cells. From a recent search by the researchers it is being observed that increases in efficiency can be achieved by using luminescent acceptor molecules. According to them, the wavelength at which the sunlight is absorbed can be 'adjusted' via the macro-modules used. For example, an office window coated with organic solar cells that absorb the red and infrared spectrum will not only screen out thermal radiation but at the same time will generate electricity. Hence the future research should concentrate on preventing the exciton from decaying which means increase its excitation lifetime. Excitons can decay by emitting light (luminescence) or heat. Multijunction cells are a way to achieve the efficiencies needed. Thin film PV technologies provide numerous ways to reduce manufacturing cost by using high-throughput manufacturing paradigms that don't require handling of individual silicon wafers. Despite the success of entrenched thin-film PV technologies, organic PV cells attract attention because the electronic and optical properties of organic materials can be changed by altering the molecular structure of the materials.

Therefore here in this article we will emphasise on the efficiency and stability rate as well as how can we get high-throughput by using various organic materials together and what are its atmospheric processing.

Keywords: Third Generation Technology, Photovoltaics, Efficiency, Stability, Solar Cell Technologies.

1. INTRODUCTION

Organic solar cell is the fastest growing technology in this era because of having few withstanding qualities such as usage of organic materials to produce energy from light, flexible, lightweight, highly tuneable & can be used for both commercial and residential purpose, have less toxicity, safe to install resulting in less damage on environment. They are also unparalleled in the number of times that they can pay back the energy used in their manufacture.

It is still a big task to overcome all barriers to develop a organic solar cells with low cost but at the same time providing high efficiency and stability rate resulting less chances to harm the environment. All existing technology were discarded because increase in the rate of global warming. Extra attention has been given to photo generation, doping effects and improvised learning of photovoltaics mechanism.

The word "Solar Radiation" refers to the electromagnetic radiation produced by the sun. Solar radiation may be captured and converted to usable energy through different technologies. The Earth spins in an elliptical orbit around the sun [1-2]. When the Sun is closer to the Planet then the more radiations reach the earth's surface. The 23.5° inclination of the Earth's axis of rotation has a greater effect on the amount of sunlight hitting the Earth at any given spot.

2. ORGANIC PV SOLAR CELL SYSTEM

Earlier solar cell technology comprises of thin silicon wafers which used to transfer sun energy to electric energy, whereas the current photovoltaic's technology is based on the principle of electron hole creation in each cell composed of two different layers (p-type & n-type materials) of a semiconductor material. Silicon, cadmium-telluride, and copper-indium-gallium are some of the materials used in inorganic photovoltaic solar cells. The energy values of the maximum occupied molecular orbits (HOMOs) and the lowest unoccupied molecular orbits (LOMOs) in this polymeric OPV content are similar to those of a typical inorganic semiconductor's valence and conduction bands [3-4].

3. ADVANCES IN SOLAR CELL TECHNOLOGY

From a very long period of time researchers have been finding ways to enhance the stability, efficiency & most importantly the life-line of solar

cell technology i.e. cost effectiveness. The average solar cell is 15% efficient which concludes that 85% of the sunlight which hits solar cell does not make electricity. As a result scientists are continuously putting efforts to test new technology to store light and process its conversion.

4. ADVANCES IN SOLAR CELL MANUFACTURING

The only way to make solar panels more powerful is to go bigger. But then having a giant solar panel, one way to create a more powerful module in the same sized footprint is to switch to bigger silicon wafers. These silicon wafers are the building blocks of crystalline silicon solar cells, which string together to become complete solar panels. The bigger the wafer, the more power it can generate because of its larger surface area.

Until now, the majority of OSC system specifications have been carried out in standard laboratory settings using solar simulators and a nitrogen atmosphere. In either case, these instruments can be used in a variety of circumstances appropriate for their implementations, including sub-atmospheric lighting, multi-sun illumination, indoor low-light illumination, and sub-water illumination. Apart from all other methods for maximising molecular packaging in active-layer films, the selective elimination of electron acceptors near the top electrode enables the fabrication of extremely stable OSCs that can operate without encapsulation in water.

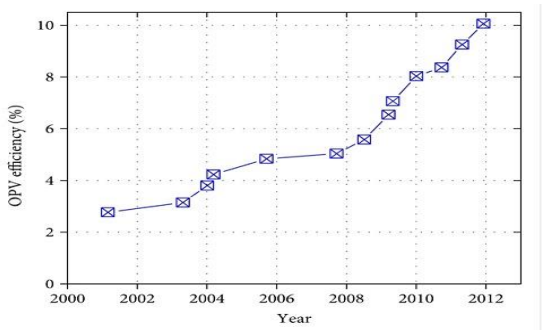

Fig.1 Yearly development of laboratory organic solar cell PCEs [3].

5. APPLICATION

There are various uses for OSCs, but one of the most realistic and significant ways to utilise solar energy is to combine a solar collector that generates electricity and hot water. SOLARUS is a Swedish corporation; measured production performance is 56% plus the hot water, making it suitable for industries that need a lot of hot water, large families, or restaurants, among others. A few examples are mentioned below:

- Solar Skin Design: The MIT spin-off has developed a "solar skin" that allows solar panels to mimic the appearance of a roof while maintaining panel performance and development.
- Solar-Powered Roads: Last summer in America, a special evaluation of solar-powered pavement technology was conducted. Since these roadways are intended to produce renewable energy, they are fitted with LED lights that illuminate the roadways at night and have the thermal heating ability to melt snow throughout the winter [5][6].
- Wearable Solar: This is not a novel term for us, since solar-powered watches and other devices have been around for many years. The main exception is that tiny solar panels will now be integrated onto garment fabric. Additionally, it may be found in a variety of home items, including window curtains and heated car seats.
- Solar Batteries (a breakthrough in solar energy storage): Off-grid solar and solar plus storage also gained attention in the United States. Although solar storage remains a costly commodity in 2019, an increase in consumer demand is projected to result in considerably more powerful and inexpensive batteries [7].

6. CONCLUSION

In summary, considerable progress has been made in the last few years toward creating a perfect OSC capable of high PCE, long-term service, and large-area manufacturing, indicating a promising future for large-scale applications. We anticipate that both OSCs and PCSs can significantly alter the global energy and environmental landscapes. It can be said that the evidence of limited global impact of PV is marked by the increasing market of fossil fuels in generating the electricity. We can't deny that OPV technology is in its early stage of development, but considering its withstanding & promising qualities like eco-friendly, flexibility, vision for mass production, large area production of fabrication which consists of spin coating, vaporization, etc OPV are considered one of the key elements in the source of energy. The review in this paper cites that there is enough room for improvement and further research in the terms of necessary OSCs technological requirements including stability, efficiency, material reliability, performance & commercialization of OPV solar cell.

7. REFERENCES

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