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A Review on Plastic (Flexible) Solar Cells

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Abstract

This article presents the significance of Plastic (flexible) solar cells for a variety of applications. Quantum confinement of nanotechnology plays a great role in altering the properties of the plastic solar cells where conducting polymers and inorganic nanoparticles are made as hybrid with increasing ratio of the flexible polymer. Plastic solar cells can be utilized in a variety of applications where ordinary solar cells cannot be used due to its rigid nature. In such a way, plastic solar cell can be covered over windows, road surfaces, satellites, portable power supplies etc. Plastic solar cells can be used even on cloudy days. This finds a best impact in the field of photovoltaics for uninterrupted power generation. These solar panels can be laid over buildings and the colour of the panel can be varied by scarifying some specific wavelength. Plastic solar cells offer high efficiency with long lasting stability and flexibility.

Keywords: Plastic (flexible) solar cells; Photo voltaic; Quantum confinement; Organic- Inorganic hybrid; Conducting Polymers;

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Introduction

Harvesting solar energy using solar cells is the key factor in utilizing the renewable form of energies. In this regard, solar cells fall under two categories, organic photovoltaic (OPV) and inorganic photovoltaic (IPV) [1]. Both OPVs and IPVs have advantages and disadvantages, OPVs tends to give higher efficiencies but its unstable nature renders a greatest hindrance and it is reverse in the case of IPVs. PV-Si solar cells accounts for the highest power conversion efficiency (PCE) of 25 % [2]. The major disadvantage of this is its increased production cost. For this, the search of low cost alternatives with increased stability are in progress in which flexible plastic hybrid solar cells comes under this strategy. Flexible plastic solar cells are made of polymers with inorganic materials in the form of blends or composites. Nanotechnology finds a major role in the designing of plastic solar cells with the concept of quantum confinement [3]. Plastic solar cells utilize the efficiency of Nanomaterial’s in the form of Nano

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rods dispersed in polymer matrix to convert the solar energy into electrical energy. These Nano rods have a thickness of about 200 nm which can produce 0.7 V which is suitable for low power devices [4]. These Nano rod devices can be designed in a constructive way to increase its efficiency to meet the suitable needs of the high power devices. Plastic solar cell is considered advantageous due to its 2 main reasons, it does not rely on the expensive silicon and manufacturing also does not require expensive equipment's as in the case of conventional silicon based solar cells. The structure of plastic solar cell consists of the photoactive layer which is sandwiched between 2 electrodes. This structure performs the operations of exaction production and dissociation. The photoactive layer of plastic solar cells is planar in nature and consists of active material in the polymer matrix with increased flexibility. Nano rods in the photoactive layer of plastic solar cells absorb photon and generate an electron which in turn is used as electricity. The main function of the active layer is the production of exactions. In plastic solar cells, the Nano rods used in the active layer produces quantum confinement effect which leads to the increase in efficiency.

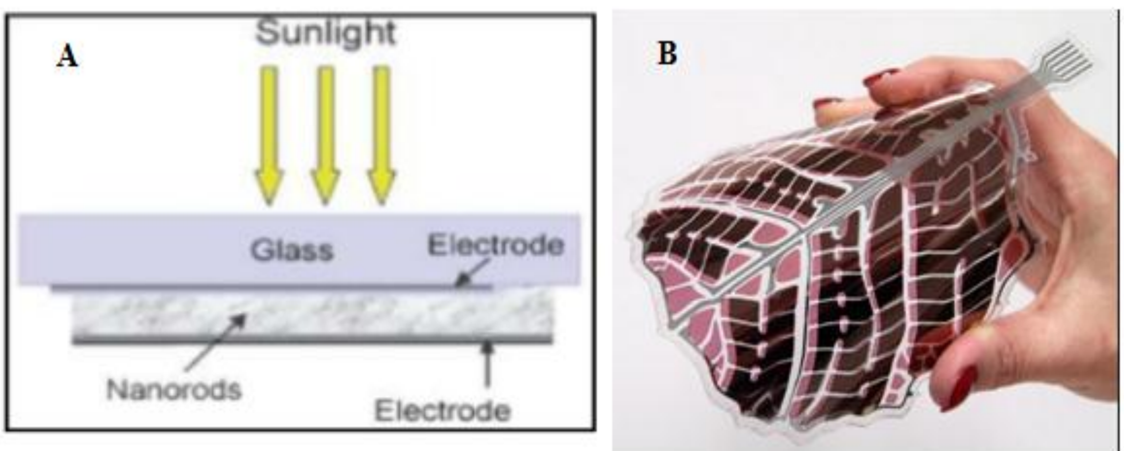

Figure 1: A. photoactive layer of Plastic solar cells [5]. **B.** Leaf module of Plastic solar cells [6].

Generally, solar cells can be used for a variety of purposes, in particular plastic solar cells due to its advantage of its flexible nature finds application in a variety of purposes where ordinary solar cells cannot play an efficient role due to its rigidity. Due to its similarity like denim, it can be dropped over any surfaces of any shape since it does not need any rigid base [7]. Moreover, the main advantage of plastic solar cells is that the active layer in it is constrained in small bead like structures within a network of electrode layers. This constrained beads acts as a Nano solar cell and produce exactions which are diffused to the electrodes with the help of optical fibers. These fibers are woven into conductive sheets which are then used to design the fabrics leading to designing of wearable solar cells which will be able to charge our mobile phones and iPods.

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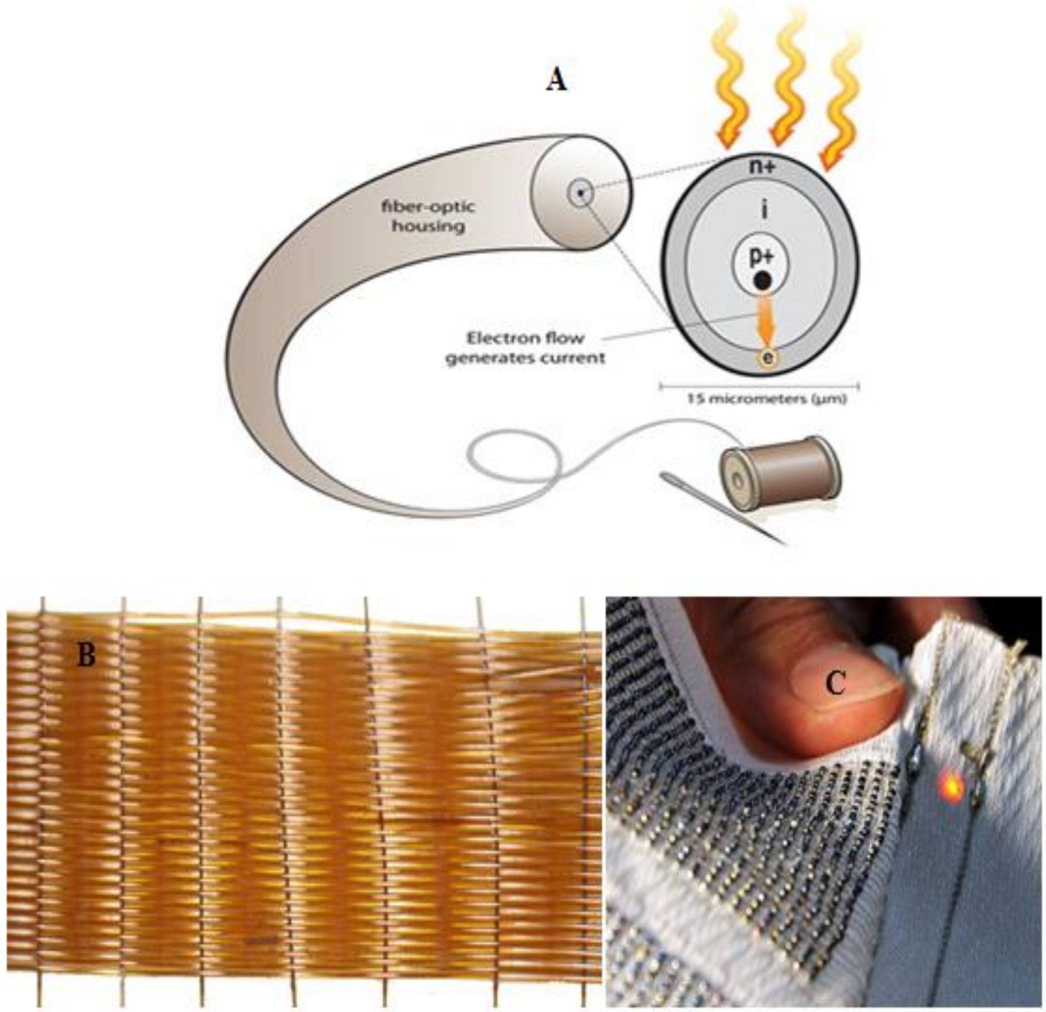

Figure 2: Flexible plastic solar cells in fabrics [8-9]. A. Nano solar cell embedded in-optic fiber. B. Optic fiber woven into conductive sheets. C. Solar powered LED embedded in a cloth.

A list of variety of applications of plastic solar cells are described below,

- Remote lightning systems
- Water pumping with solar cell
- Solar electric fences
- Solar based water treatment
- Emergency power
- Portable power supplies
- Satellites
- Toys, watches and calculators

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Figure 3: Flexible plastic solar cells in roads, buildings, solar trees and portable chargers [10-13].

Now, the research has utmost reached its peak point where the main drawbacks of solar cells of using it only in sunny day has been overcome with the invention of plastic solar cells, where this kind of solar cells can harvest solar spectrum even in cloudy day. This solar cell mainly depends on the ability of Nanomaterial's to harvest the entire solar spectrum and also it relies on the 1st generation solar cells for its enhancement in efficiency. Plastic solar cells using the Nano rods can be designed in the form of solar trees in which the solar cell is placed in the place of leafs and the fibres in trees are mimicked in the form of optical fibers having Nano rods which perform the operations of an efficient solar cell. Plastic solar cells in the form of sheet rolls can be used for battery chargers which are portable. Plastic solar cells can lead to the way of establishing solar roadways in which the flexible solar cells are mounted on to the surface of roads. The solar cells on roads are made up of materials possessing both photoactive and thermo active properties. These type of cells morphology changes with the exposure time to the sun. With the change in morphology well established structure can be obtained as the donor and

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the acceptor layer diffuses together resulting in the increased interfacial area, thus increasing the efficiency of the solar panel. Thus the morphology changes in plastic solar cells. These solar cells can be spread over the exterior surface of building and the colour of the solar cells can be matched in accordance with the building colour by scarifying a portion of the solar spectrum. This exclusion of the certain wavelength may not affect the overall efficiency of the solar cell by a large ratio. Such type of solar panels has an inbuilt sensor and is referred to infrared solar panels which even do not need direct sunlight and can be active in minimal sunlight. Semi-transparent flexible solar panels also offer the same advantages. The advantages and applications of plastic solar cells extend to an unlimited range for harvesting the solar energy. Thus the flexible plastic solar cells due to its versatile nature are a suitable technology to meet the energy demands.

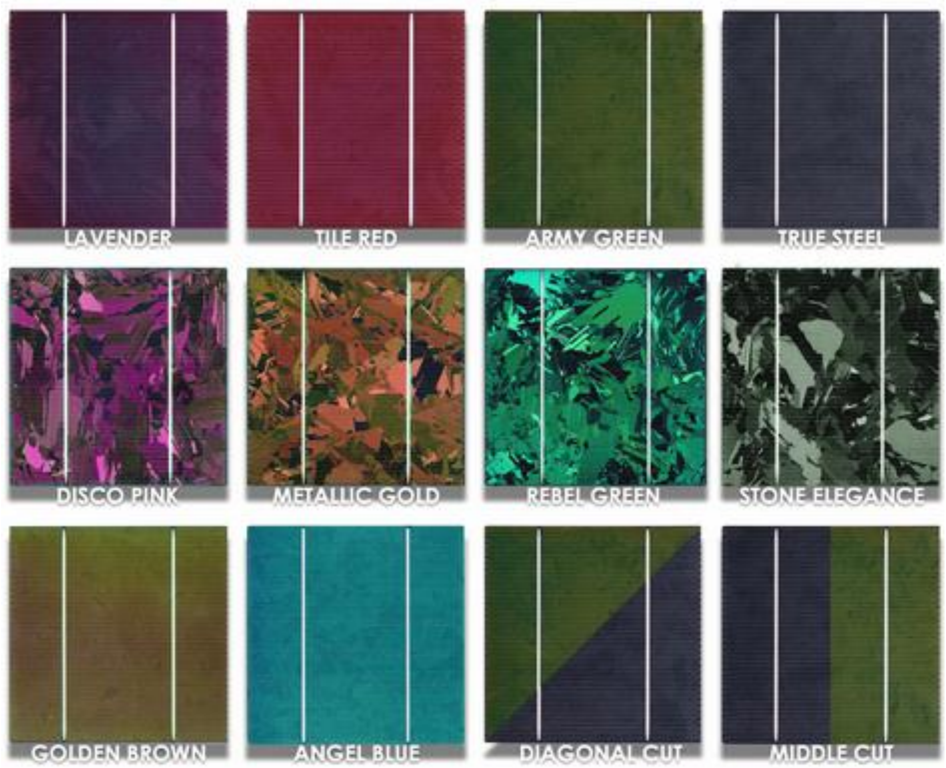

Figure 4: Flexible plastic solar cells in an array of colours [14].

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