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Hybrid Solar Cells: A Step Closer to Smart Life

Rajib Biswas

Department of Physics, Tezpur University, Tezpur, India

ABSTRACT

Solar cells come a long way since its invention. The stupendous growth of solar cells has opened many new avenues in many industrial sectors. Sunlight, being the primary source of solar cells is often shadowed by weather conditions such as heavy clouds, fogs, heavy rainfall etc. As such, the performance of solar cells wanes in such weather conditions. To tackle this, the concept of hybrid solar cells emerges which can cater to these weather anomalies and deliver power in bad weather too. This brief opinion article tries to appraise readers regarding the developments of hybrid solar cells.

***Corresponding author**

Rajib Biswas, Department of Physics, Tezpur University, Tezpur, India. Email: rajib@tezu.ernet.in

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Introduction

Solar radiation is ubiquitous. This plentiful energy source is quintessential in the overall functioning of sustainable energy. Apart from being the lifeline of our habitable planet, solar radiation fuels many applications from our household activities to heavy industrial applications. However, human race is unable to harness the full potential of solar radiation. Figures indicate that 10K times of world's total consumption of energy can be accrued from solar radiation that reaches our earth [1]. Only a meager portion of solar energy is harvested [2]. Being a clean source of energy, there is no scope of pollution. Notably, solar cells are the primary sources of solar energy harvesting/storage. These cells store energy and then the stored energy is then utilized in executing certain jobs. Gradually, solar cells have become a part and parcel for our day-to-day life. However, proper daylight is mandatory for useful energy harvesting. When there is bad weather such as heavy rainfall, cloudy day etc., the energy storage capacity of solar cells dwindles. This impairs the full potential of solar cells. To circumvent such problems, it is imperative that there must be some sort of mechanisms or ways by which solar cells can be operable in bad-weather conditions too. There arise hybrid solar cells which can alleviate such hurdles. This brief opinion article appraises readers about these new developments.

Operation

The advancements of new photovoltaic technologies over the past decades bring huge optimism about harvesting and using solar energy to fulfill a much larger portion of the global energy requirement. However, it remains a challenge to improve the efficiency and cost-effectiveness of generating electricity from solar radiation. The efficiency of the present photovoltaic systems must be enhanced if we wish to successfully substitute fossil fuels for large scale power generation.

A solar cell yields voltage and current when solar radiation falls on the surface of it—being termed as the photovoltaic effect. This does not require any external energy. The power conversion efficiency, η gives the fraction of incident energy that is converted into electrical energy. It engages the ratio of the maximum energy output from the cell to the incident energy on the cell.

η= (maximum power output)/(power of incident light) (1)

Similarly, the maximum power output, P_{MAX}, I_{SC} short circuit current, the open circuit voltage V_{OC} and the fill factor FF are linked as

$$P_{MAX}=I_{SC}\ V_{OC}\ FF \quad (2)$$

Equations (1) and (2) implicate that the efficiency of a solar cell directly depends on the fill factor, FF. In fact, the fill factor is a very significant parameter that is used as a quality parameter in the study of solar cell performance. Optimizing solar cell performance inevitably requires the optimization of the fill factor. The fill factor is affected by physical and environmental influences, temperature and the wavelength range and irradiance of the incident irradiation.

Hybrid Solar Cells

Newly developed hybrid solar cells can generate power from raindrops. This hybrid system can harvest energy in all sorts of weather conditions. The hybrid solar cell is a perfect fit for places where it frequently rains.

Previous studies added a triboelectric nanogenrator (TENG) to an existing solar cell, creating a device that can make energy from the motion of the raindrops [3]. However, these devices are usually bulky and complicated to manufacture. The new study improves the TENG by adding a textural layer that acts as a mutual electrode for both the teng and the solar cell. It is placed between the two devices and conducts energy from the TENG to the cell.

The solar cell could still generate energy from sunlight as well as from falling raindrops, because the polymers are transparent. The shared electrode not only results in design that is more compact, but it also offers advantages to both the solar cell and the TENG. The TENG protects the solar cell by acting as a waterproof barrier and prevents water from penetrating the Silicon. The textured surface also suppresses unwanted reflection of light, which greatly enhances light harvesting. Furthermore, the textured surface results in a greater contact area. Between the TENG and falling raindrops, which overall improves the performance of the nanogenerator. The only drawback is that the solar cell and nanogenerator cannot work together. If there is sunshine; sun shower and raindrops appearing at the same time, we have to give up one function of the hybrid generator. This is due to the design of the hybrid generator. The hybrid generator is lightweight equipped with high efficiency. Scientists are now preparing a fiber shaped devices and expect to weave it as fabric to be worn as cloth. They hope to fabricate clothing that can generate electricity from sunshine and raindrops and then use this electricity to power wearable power electronic devices. Other innovations in solar cell design include using the mineral perovskite as a flexible and efficient light harvesting active material and researching artificial photosynthesis, which uses sunlight to produce liquid, and gas fuels.

Concluding Remark

Summarily, this short article describes the hybrid solar cells having unique capabilities. They can work in extreme weather conditions too. With the advent of recent advancements in fabrication as well as nanotechnology, it is expected that the lacunae faced by these hybrid cells could be overcome. Moreover, mass scale production will also be another challenge so as to cut down the overall cost. All these can be ensuing in the days to come.

Declaration of Conflict of Interest

Author has no conflict of interest.

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