Dye- Sensitized Perovskite Solar Cell

Amit Kumar, Suraj Kumar, Sunil K. Choudhary and Vicky Kumar
Electrical & Electronics Engineering department
R.V.S. College of Engineering & Technology
Jamshedpur, Jharkhand, India

***Abstract*—Perovskite structured solar cells are manufactured using organic and inorganic hybrid materials. These solar cells have lightweight small size and better reliability in all respects as compared to silicon solar cell. Also the durability of these solar cells are not less than any other. Perovskite structured solar cells unbound the limitations of traditional solar cells. It will reach from the roof to the doors and windows. In this paper, we present an overview of the Perovskite structured solar cells.**

Keywords—Solar Cells;Perovskite;Reliability

I. INTRODUCTION

A solar cell converts the light energy into electrical energy. The first solar power generator was displayed by "Augustin Mouchot" at the Universal Exhibition in Paris in the year 1878 [1]. From that time till now, there is great variation in the design and element used in solar cell. The latest element of research in a solar cell is "Perovskite - structured element. Perovskite is a material consisting of Calcium Titanium oxide mineral, i.e. Calcium Titanate ($CaTiO_3$). It was discovered in the Ural Mountains of Russia by "Gustav Rose" in 1839. The Perovskite – structured element have a crystal structure ABX_3 where X is any halogen element and is shown in Fig. 1.

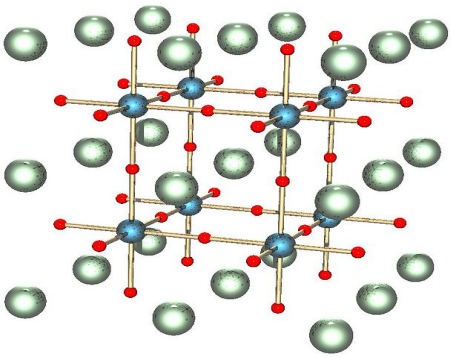

Fig.1. Perovskite Crystal Structure

The most common perovskite – structured element used for solar cell is hybrid organic-inorganic lead or tin halide based elements as light absorbing layer. These perovskite structured materials are cheap and easy to manufacture. Hence it is more reliable than the silicon solar cell. The research work on the perovskite solar cell has raised its efficiency from 3.8% in 2009 to 21.0% in 2015 [1]. These perovskite solar cells have the potential of achieving even higher efficiency and also it has lower production cost and is more reliable, so these cells are important from a commercial point of view.

II. DESCRIPTION OF STRUCTURE

The perovskite structure material has crystal structure ABX_3. The most commonly used perovskite materials are

- Methylammonium lead trihalide ($CH_3NH_3PbX_3$)
- Formamidinum lead trihalide ($H_2NCHNH_2PbX_3$)

(Where X in any halogen such as Iodine, bromine or chlorine)

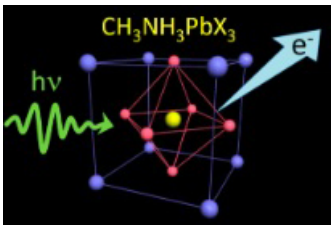

Fig.2. Structure of Methylammonium lead trihalide

The optical bandgap of these materials are 1.5 eV and above. This bandgap is near about the optical bandgap of silicon, which is about 1.1 eV. The most important feature of perovskite – structured solar cell is that the optical bandgap of these materials can be varied by varying the halide content. Thus, it gives a future scope to harvest solar energy in bad weather condition. The most attractive feature of perovskite – structured solar cell is reliability in manufacturing. Methylammonium lead trihalide or Formamidinum lead trihalide can be manufactured easily in ordinary labs with proper resources. Talking about the durability, perovskite structured material do not have any experimental data, but it is expected that the life span of perovskite structured solar cell is not less than that of the silicon solar cell. Also, these solar cells are semitransparent. So the solar energy which is reflected by silicon solar cells, can be used for other work. This will increase the overall efficiency of the system.

III. ADVANTAGES

The main problem with the presently available solar cell is its huge mass, large size and high cost. Also, these solar cells are limited to rooftops or in open ground. But perovskite – structured solar cell is an answer to all the above problems discussed. Also perovskite – structure solar cell unbound the limitations present with the available solar cell. The power generated by 10 mm thick silicon solar cells can be generated by perovskite – structured solar cell of 1 mm thickness. This

large size reduction and huge weight reduction make it more reliable for use. Also, these perovskite – structured solar cells are semi-transparent, so these solar cells can be used at window, doors and for glass roofs. This will help in harvesting solar energy without compromising the interior of exterior decor. The light weight of perovskite – structured solar cell also opens a path for the hybrid system. These solar cell open a way for re-designing the blades of wind turbines using these solar cells.

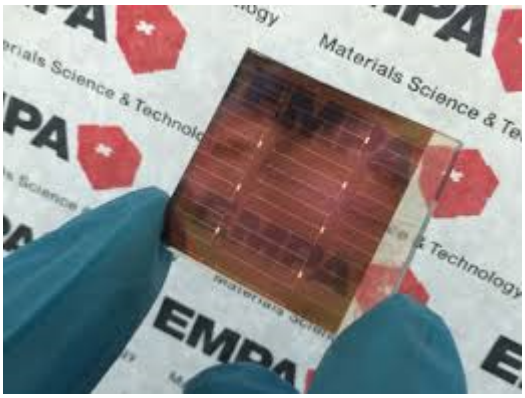

Fig. 3. Perovskite Solar Cell

This will help in harvesting solar energy without compromising the interior of exterior decor. The light weight of perovskite – structured solar cell also opens a path for the hybrid system. These solar cell open a way for re-designing the blades of wind turbines using these solar cells. Not only in homes and offices, perovskite solar cells can be used in cars as their window glass.

IV. LIMITATIONS OF PEROVSKITE-STRUCTURED SOLAR CELL

The main drawback of the perovskite-structured solar cell is its lower efficiency. The highest efficiency of solar cell is about 41%. At starting the efficiency of perovskite solar cells was about 1%. But continuous research work as increased its efficiency from 1% to about 21%. The efficiency of silicon solar cell is about 25% [2]. Though the efficiency of the perovskite solar cell is low, but considering the cost as other factor, perovskite solar cell leads. Also researches are going on for improving the efficiency of the perovskite solar cell.

V. COMPARISON

Classification	Efficiency	Transparency	Cost
Triple Junction Solar cell	41.1%	No	High
Silicon Solar Cell	25%	No	Average
Perovskite solar cell	21%	Semi	Low

VI. CONCLUSION

- Perovskite solar cells have efficiency near about the efficiency of silicon solar cell.
- The manufacturing of perovskite solar cell is reliable than silicon solar cell.
- The cost of perovskite solar cell is less than the silicon solar cell.
- It is more reliable for the hybrid system of solar and wind energy.

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