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The influence of thickness layers on the efficiency of MAPI solar cells

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ABSTRACT*:*
The recycling of vehicle batteries to produce Perovskite solar cells (PSCs) is done in this study using a simple technique. attempting to remove certain objects or things from the surroundings. However, by recycling vehicle batteries, we may avoid disposing of hazardous battery components and offer a different method a widely accessible source of Pb for making PSCs. On an FTO glass substrate, perovskite solar cells (PSCs) were created using a two-step spin coating solution process. The precursor ($CH_3NH_3PbI_3$) is made up of lead iodide (PbI_2) and methyl-ammonium iodide (CH_3NH_3I). Investigated were the photovoltaic performance of PSCs and the impact of the perovskite layer's chemical composition on that performance.

KEYWORDS: Perovskite, Solar cells, Efficiency, Fill Factor

INTRODUCTION

The Earth receives an incredible supply of solar energy. The sun, an average star, is a fusion reactor that has been burning over 4 billion years. It provides enough energy in one minute to supply the world's energy needs for one year. In one day, it provides more energy than our current population would consume in 27 years. In fact, "The amount of solar radiation striking the earth over a three-day period is equivalent to the energy stored in all fossil energy sources." Capitalize from this huge amount solar energy people were struggling since 18th century by introducing the solar thermal collector. The first ever solar thermal collector was invented by A Swiss scientist, Horace de Saussure. [1] Producing the electricity directly from the solar energy was the second discovery. This technology was discovered by Alexander Edmond Becquerel, who was a French

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physicist at the year of 1839. This was the beginning of the solar cell technology. [2] Solar cells are usually divided into three main categories called generations up to recent years. The first generation contains solar cells that are relatively expensive to produce, and have a low efficiency. The second generation contains types of solar cells that have an even lower efficiency, but are much cheaper to produce, such that the cost per watt is lower than in first generation cells. The term third generation is used about cells that are very efficient. Most technologies in this generation are not yet commercial, but there is a lot of research going on in this area. The goal is to make third generation solar cells cheap to produce.

The third generation solar cells (PSCs) halide Perovskite organic-inorganic solar cells must involve a countless contract of care of solar cell study public unpaid to an absurd maneuver proficiency development subsequently 3.8% to more than 20 % since 2009 [3,4]. Since 2012, methylammonium lead halide (MAPbX3, where MA is methylammonium CH3NH3 and X is a halogen) Perovskite-based photovoltaic devices have been studied intensively [5–11]. PSCs not only solve the energy crisis, but also reduce CO2 emissions, which cause global warming and the elimination of toxic emissions from old car batteries to serve solar energy. Basically, PSC resources are needed, which is the band gap of the thin active layer of Perovskite (CH3NH3PbX3) (1.5 eV to 2.3 eV) [12], and great light absorption coefficient (higher than 10^4 cm^{-1}) [13,14], which is similar to other thin film solar cell materials such as CdTe [15] and copper zinc tin sulfide (CZTS) [16].

METHODOLOGY

Harvesting material from the anodes and cathodes of a vehicle battery after using a metallic harvester to separate the car battery (12 V, 799.7gm lead).The electrolyte acid was removed and carefully reconstituted, and the electrodes and inner battery barrier were washed periodically with lots of clean water. A portion of the electrode boards were then exposed from the sides after the top cover of the dry automobile battery had been removed. After being steamed, the materials made of lead were separated from the storage rings by lead (the anode) and lead dioxide (the cathode), and then they were cleaned with diluted hydrochloric acid and gradually increasing amounts of water. For better mixing, prefix the components together. Using a ceramic crucible, lead dioxide (PbO_2) can be employed in a muffle furnace.

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RESULT AND DISCUSSION

Ag/CuI/MAPI/SnO_2 Nano films were used as the structural component of solar cells, and in this case, the MAPI film serves as the active layer in a photovoltaic material. We must research the electrical characteristics of this layer in order to confirm the validity of the construction of the MAPI film to function as an active layer while operating the gadget.

The I-V curves were measured with an active area of 1 cm2 and an air mass (AM 1.5) of 100 mW/cm^2.A solar cell with an Ag/CuI/MAPI/SnO2 Nano films structure is coupled to an active layer in a photovoltaic device to test the practicality of the $MAPbI_3$ film created in this work. The I-V curves of the solar cells made with MAPI film as the active layer are shown in Figure 1.

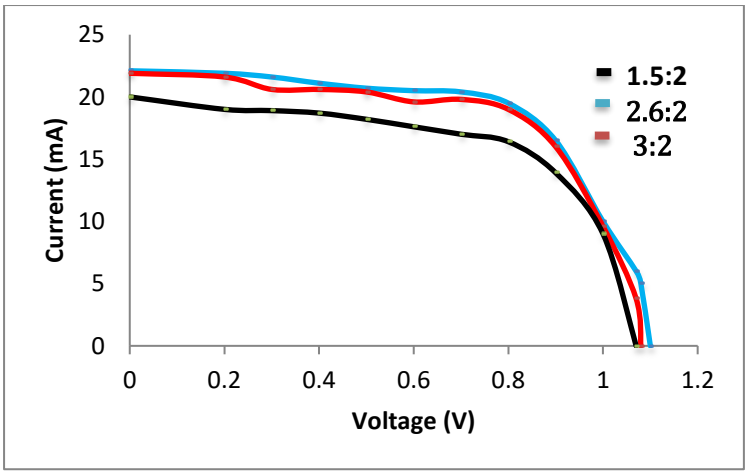

Fig. 1. I-V curves of perovskite solar cells made with the following composition: Ag/CuI/MAPI/SnO_2 on FTO glass substrate with different thickness ratios (a) 1.5:2, (b) 2.6:2, and (c) 3.0:2.

Short circuit current Jsc, open circuit voltage V_{oc}, fill factor FF, and efficiency are the values of the relevant performance characteristics shown in Table 1. Additionally, the influence of the chemical composition of films on the performance parameter is described. These match the figures provided by other authors.

Table (1). Performance of the cell (short circuit current (Isc), open circuit voltage (Voc), fill factor (FF), and efficiency) as a function of chemical composition.

Sample	Thickness ratio	I_{sc} (mA)	V_{oc}(V)	FF	η (%)
S_1	1.5:2	18	1.06	0.404	8.8
S_2	2.6:2	18.7	1.04	0.467	8.9
S_3	3.0:2	18.8	1.03	0.423	9.2

Fig. 1 shows this, as expected. Low FF and low short circuit current (J_{SC}) are the main causes of the low efficiency, and the device's high series resistance contributes to low FF. The restructuring of the trap center in the deterioration zone has an impact on the quality indicator of the diode, which is another factor that influences the FF. Evidently because the CuI/MAPI and SnO_2/MAPI interfaces have limited charge transfer.

A significant loss of photocurrent may also contribute to a loss of short circuit current as a result of the recombination of interface states. The information shown in Table (1) demonstrates that the short-circuit current, maximum short-circuit current, and efficiency attained in the film produced with a thickness ratio of 3.0:2 will all be significantly affected by the annealing deposition of the solar cell layer.Additionally, it has been discovered that under these circumstances, films made with a thickness ratio of 3.0:2 can produce the best levels of efficiency, limiting the formation of new phases and displaying better shape and crystal structure.

CONCLUSION

In conclusion, a suitable thin film property was created utilizing a two-step spin coating solution approach using lead iodide generated from car batteries and methylammonium iodide as precursors. Our solar cells had a 9.2% efficiency. It was discovered that the $CH_3NH_3PbI_3$ films produced using Pb from car batteries with a thickness ratio of 3.0:2 (PbI_2/MAI) exhibit good efficiency and a high fill factor, and these films are more efficient than samples made using different molar ratios.

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