ID: 1064

Study of a Stack of Perovskite/PEDOT: PSS for Solar Cells in Ambient Conditions

BOUHADEF Yasmina[1], TIGHILT Fatma Zohra[2], BELHOUSSE Samia[2], LASMI Kahina[2], BELHANECHE Naima[1], SAM Sabrina[2]

[1]National Polytechnic School, 10 Rue des Frères OUDEK, El-Harrach, Algiers, Algeria
[2] Division Couches Minces Surfaces Interfaces (CMSI), Centre de Recherche en Technologie des Semi-conducteurs pour l'Energétique (CRTSE), 2 Bd. Frantz Fanon, B.P. 140, Alger-7 merveilles, Algiers, Algeria
*Corresponding author's email: yasmina.bouhadef@g.enp.edu.dz

ABSTRACT

Over the recent years, we have witnessed significant progress in the development of organic-inorganic halide perovskite solar cells (PSCs), resulting in highly efficient solar technology. Poly(3,4-ethylenedioxythiophene): polystyrene sulfonate (PEDOT: PSS) has been widely used as the hole transport material in optoelectronic devices. In our work, the structure elaborated was composed of FTO/ (PEDOT: PSS)/ perovskite/ C60/Al. We focused on the perovskite film preparation and our experiments revolved around two key aspects: The first involved optimizing the solution-processing parameters. After experimenting with various formulations and preparation methods of the perovskite precursor solution, our attention turned to the use of triple cations perovskites Cs(MaFa)PbBrI, described as more stable and less sensitive to processing conditions [1]. We also made adjustments to the spin-coating deposition and annealing parameters, including deposition speed (2000 rpm to 6000rpm), duration (15min to 30min), as well as annealing temperatures (60 to 120°C). Secondly, we replaced the conventional anti-solvent strategy with a vacuum-based method. This method involves placing the perovskite film within a vacuum container to boost rapid crystallization of the perovskite by removing most of the residual solvents. The thickness of PEDOT: PSS was controlled by deposition speed. The surface morphology was studied by scanning electron microscopy (SEM). The absorbance of our structure was measured by UV-Visible spectroscopy and contact angle measurements were used to investigate the hydrophobicity surface. We achieved positive results, leading to the development of stable perovskite films able to endure ambient air conditions for extended periods.

Keywords: Perovskite, Solar cells, Renewable energy

1. Introduction

Perovskite solar cells have gained significant attention in recent years due to their potential for high efficiency, low-cost manufacturing, and versatility in terms of design and application. They can be fabricated using simple and scalable solution-based processes, which makes them attractive for large-scale production [2]. Overall, perovskite solar cells hold great promise for the future of solar energy, offering a potentially cheaper and more efficient alternative to traditional solar cell technologies. Ongoing research and development efforts aim to address the remaining challenges and further enhance the performance and commercial viability of perovskite solar cells [3]. In just a few years of development, perovskite solar cells have already reached efficiencies comparable to traditional silicon solar cells, with some laboratory prototypes exceeding 25%. However, these advancements are accompanied by challenges as PSCs exhibit a high sensitivity to ambient atmospheric conditions, including factors like air, water, light, and temperature, perovskite materials are sensitive to moisture and can degrade over time, affecting their long-term stability and durability. As a result, achieving high-efficiency PSCs often requires researchers to rely on the use of a well-controlled glove box filled with inert gas or dry air. Additionally, many of the high-efficiency PSCs presented in the literature make use of halogenated anti-solvent strategies to facilitate perovskite crystal growth. These methods not only increase the cost but also hinders large-scale manufacturing. In response to these challenges, our research aims to shift the fabrication process of perovskite solar cells from the controlled environment of a glovebox to ambient air conditions. In our work, the structure elaborated ambient air conditions, was composed from FTO/ (PEDOT: PSS)/ perovskite/ C60 by replacing the

DOI: 10.21467/abstracts.169 ISBN: 978-81-970666-4-1 (eBook)

conventional anti-solvent strategy with a vacuum-based method.

2. Experimental

The device structure is FTO/PEDOT: PSS/perovskites Cs(MaFa)PbBrI/C60/Al. The FTO glass substrates were cleaned in detergents, ethanol, distilled water, and isopropanol. Then, the FTO substrates were dried by nitrogen. The PEDOT: PSS solution was diluted by varying contents of water and spin coated on the FTO substrate varying speed deposition and then annealed at 120 °C for 15 min. For the preparation of perovskite solution, a precursor solution was prepared by dissolving salts in a mixture of solvents. After that, the perovskite was spin coated on FTO/PEDOT: PSS substrate and finally the C60 solution was deposited on perovskite by spin coating and then Al contacts was elaborated.

3. Results and Discussion

Figure 1 shows the surface morphology of FTO/PEDOT: PSS/ Perovskite surface and FTO/PEDOT: PSS/ Perovskite/C60.

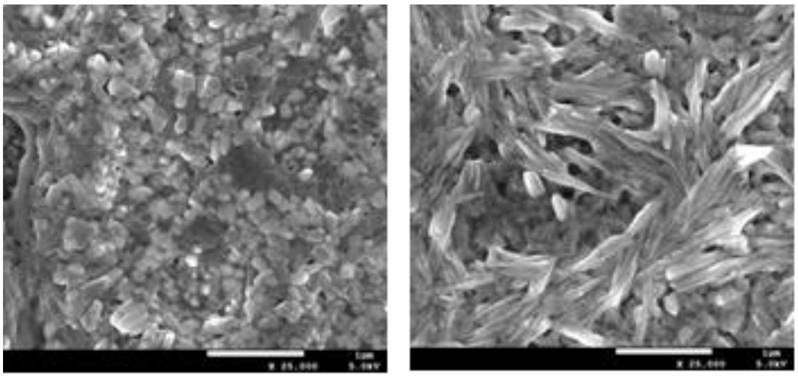

Figure 1: PEDOT-PSS/Pérovskite PEDOT-PSS/Pérovskite/C60

3. Conclusions

Positive results were observed leading to the development of stable perovskite films in ambient air conditions for extended periods.

References

[1] Saliba M., Matsui T. and al., Cesium-containing triple cation perovskite solar cells: improved stability, reproducibility and high efficiency, Energy Environ. Sci., 2016, 9, 1989-1997.

[2] Rahula., Bhattacharyab B., Singh P. K., Khana Z. H., Guptab M., Comparative Photovoltaic Study of Lead and Tin based Perovskite Sensitized Solar Cell using Polymer Electrolyte, Int. J. electroactive Mater., 5, 13-18, 2017.

[3] Wen J., Zhao Y., PuWu., Liu Y., Zheng X., Lin R, Wan S. KeLi, HaowenLuo., Tian Y., Li L. and Tan H., Heterojunction formed via 3D-to-2D perovskite conversion for photostable widebandgap perovskite solar cells, nature communication, 2023.

ISBN: 978-81-970666-4-1

Series: AIJR Abstracts
DOI: 10.21467/abstracts.169