

Flexible Perovskite Solar Cells

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Abstract

Flexible electronics, especially flexible solar cells, have attract great attention due to their light-weight, wider application fields, and low cost. In this report, the development of PV in China is introduced first. Perovskite solar cells, rising as a next generation energy conversion star, is then introduced. The cost and the future of the solar cells are analyzed.

Our company is devoted to industrialize of perovskite solar cells, especially flexible perovskite solar cells. The production of our processing is introduced briefly. And the performance of the flexible solar cells in our laboratory is introduced. A champion efficiency of 19.05% has been achieved. The flexible solar cells show good environmental stability and bending properties. In conclusion, our flexible perovskite solar cells show good potential for industrial applications.

1. Introduction

The photovoltaic technology has been greatly developed in the past decades. As a significant component of new energies, the development of photovoltaic power generation is highly valued by lots of countries. As reported, in 2014, the total installed capacity of PV was 178GW all over the world, while in 2019, the total installed capacity of PV in the world will reach 540GW [1]. PV has made great contribution to reduce the use of traditional fossil energy, alleviate environmental pollution, save energy and reduce emissions. For example, A 300 kilowatts of distributed photovoltaic rooftop power station at Beijing Haidian District, which can generate 330,000 KWH a year, and save 112 tons of standard coal, can reduce 90 tons of dust emissions, 110 tons of ash, 350 tons of carbon dioxide, 10 tons of sulfur dioxide, 5 tons of fuel dust and 5 tons of nitrogen oxides for the society [2]. The results are really surprising.

However, with the rapid growth PV industry, the Feed-In Tariff from Chinese government is greatly decreased. In view of the current situation of the development, the Chinese government issued a notice on the reduction of Feed-In Tariff on May 31, 2018 [3]. The aim is to force PV enterprises to accelerate the pace of technological innovation and reduce the non-technical cost, and promote the healthy and orderly development of the photovoltaic industry.

In recent years, perovskite solar cell, a star in the field of PV, has attracted much attention due to its high efficiency, low cost, simple process and environmental protection. As

we all know, efficiency of rigid devices had increased from 3.8% in 2009 [4] to 22.7% in 2017, and the record had exceeded the second generation of thin-film solar cell (CIGS (22.6 %))[5]. Flexible perovskite solar cells are of great concern because of their flexible properties, which makes up for the deficiency of rigid devices and expands the application of perovskite solar cells in daily life. For example, it can be applied to solar-powered backpacks, solar-powered cars, solar-powered aircraft and building integrated photovoltaic, and so on.

2. General Instructions

Our company focuses on the development of flexible perovskite solar cells by solution-processing. Electron transport layer, perovskite layer and hole transport are deposited on flexible PEN/ITO substrates step-by-step by slot-die coating method. By tuning the structure of the tri-layer and the morphology of perovskite film, we have achieved an efficiency of 19.05% on a laboratory-scale flexible solar cell.

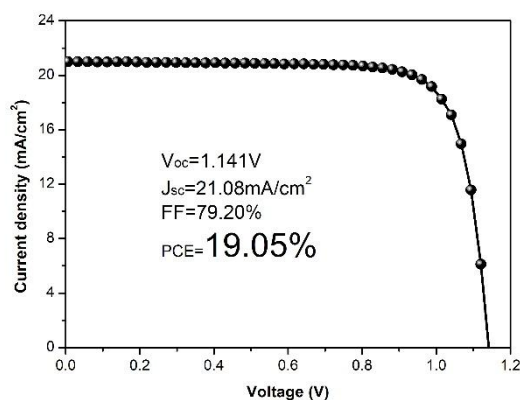


Fig. 1 The champion J - V curve of the flexible PSCs.

In addition, we improved the mechanical properties of the flexible perovskite solar cells by modifying the carrier transport layer. As shown in the Figure 2, the flexible perovskite solar cell fabricated by our company can maintains over 90% of the original efficiency after 2000 cycles with a bending radius of 10mm.

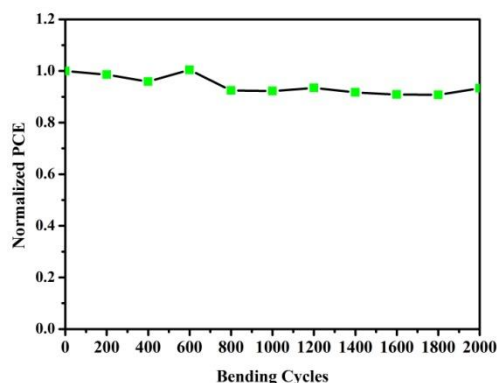


Fig. 2 The bending resistance of the flexible PSCs during bending 2000 cycles at a curvature radius of 10 mm at $\approx 30\%$ relative humidity.

3. Conclusions

Perovskite solar cells, especially flexible devices, show good potential in the future energy markets. We have fabricated flexible perovskite solar cells with a champion efficiency exceeding 19.05% and long-term stability. What's more, the efficiency of the flexible device can still maintain more than 90% of its original efficiency, under the bending radius of 10mm after 2000 cycles.

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References

- [1] Ansari M I H, Qurashi A, Nazeeruddin M K,. Journal of Photochemistry & Photobiology C Photochemistry Reviews, 2018, 35:1-24.
- [2] <<http://news.cableabc.com/project/20151123169885.html>>.
- [3] <http://www.nea.gov.cn/2018-06/01/c_137223460.htm>.
- [4] A. Kojima, K. Teshima, Y. Shirai and T. Miyasaka, J. Am. Chem. Soc., 2009, 131, 6050-6051.
- [5] <<http://www.nrel.gov/ncpv/images/efficiencychart.jpg>>.