pv magazine

20 March 2023

Beatriz Santos

English translation

A lead-free perovskite solar cell achieves an efficiency of 24.1%

Singapore researchers have developed a perovskite solar cell using a new method to synthesize the coating without using lead. The cell is coated with a zinc-based compound and has a conversion efficiency of 24.1%.

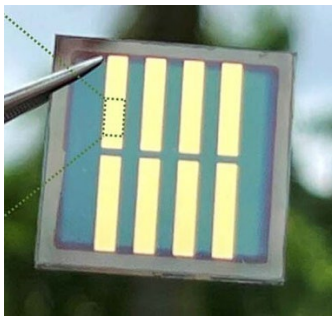

Image: NTU

Scientists from Nanyang Technological University (NTU) and the Singapore Agency for Science, Technology and Research (A*STAR) have developed a new way to synthesize the coating layer of perovskite solar cells without using lead.

“This paves the way for the development of eco-friendly perovskite solar cells that are one step closer to market,” an NTU spokesperson told pv magazine. "The findings open up new opportunities to develop superior coating layer materials for more efficient and stable perovskite solar cells."

The cap layer of perovskite cells is usually made using the half precursor (HP) method, in which a chemical precursor is deposited on top of the perovskite layer. The precursor reacts with the lead ions present in the perovskite layer and forms a lead-based chemical that forms the coating layer.

To make perovskite solar cells more environmentally friendly, NTU scientists developed a new method known as full precursor (FP) solution. They coated the perovskites with solutions containing metal halide salts and phenethylammonium iodide (PEAI).

"PEAI contains ammonium, a positively charged ion that contains nitrogen and hydrogen, which is vital for the chemical reaction," the NTU explained in a statement.

The team synthesized a zinc-based compound known as PEA_2ZnX_4 using the FP method and found that it was the most effective coating material among the other materials tested. They then created a prototype solar cell coated with the zinc compound.

“Unlike the HP method, with the FP method it is not necessary to extract lead ions from the underlying perovskite layer to form this protective layer. This paves the way for the use of non-toxic metals in the coating layer,” the scientists state.

The perovskite cell has a conversion efficiency of 24.1% under laboratory conditions. The prototype demonstrated an average light conversion rate of almost 23% in 103 cells tested. It maintained more than 90% of its capacity to convert light into electricity during more than 1,000 hours of operation at full capacity.

The scientists are working on scaling up the method to make full-size solar cells. They are also filing for a patent with NTUitive, NTU Singapore's innovation and entrepreneurship company.

They shared their findings in "Expanding the low-dimensional interface engineering toolbox for efficient perovskite solar cells," recently published in *Nature Energy*.