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NEWS | AUGUST 17 2022

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Mara Johnson-Groh

Scilight 2022, 341102 (2022)
https://doi.org/10.1063/10.0013774

AIP Publishing

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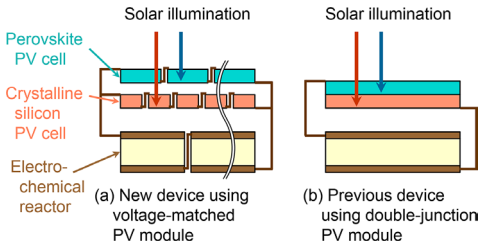
By matching the voltages of photovoltaic modules and electrochemical reactors, researchers improved the energy conversion efficiency in artificial photosynthesis devices.



In a rapidly warming world, many researchers are exploring new renewable energy technologies. Artificial photosynthesis is one leading avenue for sustainably creating hydrogen and hydrocarbon fuels and one group has made a breakthrough in improving its energy efficiency.

Takeda et al. designed an artificial photosynthetic device with a voltage-matched perovskite-silicon tandem photovoltaic (PV) module. Previously, artificial photosynthesis devices were made from double-junction PV modules and connected electrochemical (EC) reactors with mismatched voltages thought to optimize each stage's efficiency.

"But the electric-generating capacity of that previous design cannot be fully exploited because of the low coupling efficiency between the PV modules and EC reactors," said author Yasuhiko Takeda. "We solved this by creating a better matching between the PV modules and EC reactors."

Their design used voltage-matched PV modules with multiple series-connected EC reactors and employed a common combination of organic-inorganic hybrid perovskite top cells with crystalline silicon bottom cells.

The matching resulted in around a five percent higher solar-to-chemical energy conversion efficiency than previous PV modules. Additionally, the design can be easily adopted for commercial use because it can be built with common materials and existing technology at low cost.

The authors were motivated to undertake this study due to a sense of crisis for global warming. They hope the findings can be improved on by other researchers and eventually lead to widespread usage that could boost the renewable energy sector and help combat climate change.

"We believe these findings are one of the most promising ways toward a sustainable society with carbon neutrality in the near future." Takeda said.

Source: "Artificial photosynthetic monolithic devices using voltage-matched perovskite/silicon tandem photovoltaic modules," by Yasuhiko Takeda, Ken-ichi Yamanaka, Takeshi Morikawa, and Naohiko Kato, Toyota Central R&D Labs., Inc., *Journal of Applied Physics* (2022). The article can be accessed at https://doi.org/10.1063/5.0097485.