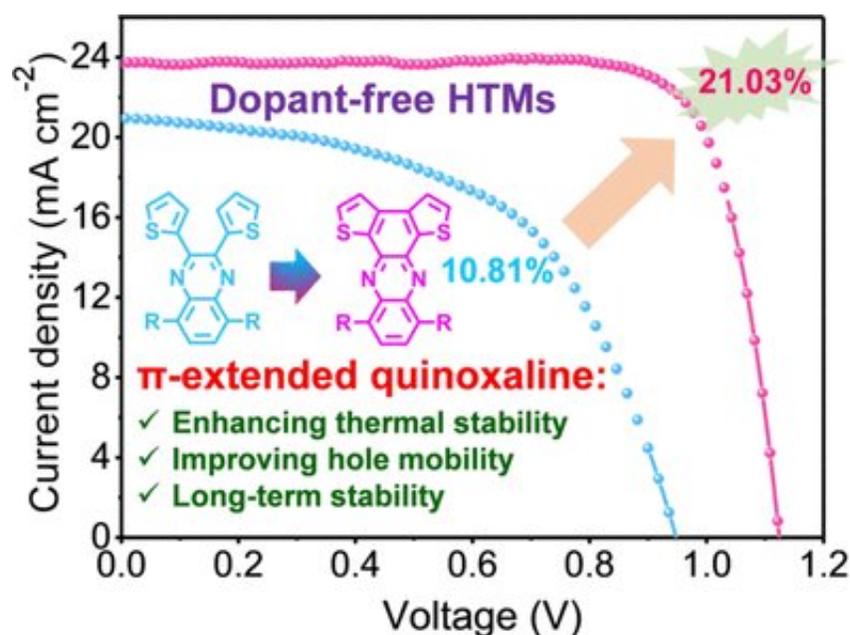


Dopant-free, humidity-stable organic layers give perovskite solar cells 21% efficiency

January 18 2021



Credit: Wiley

Durable, high-performing perovskite solar cells also require durable, high-performing charge-transporting layers. Scientists have developed the first organic hole transporter that does not need a dopant to attain high charge mobility and stability. According to the study published in the journal *Angewandte Chemie*, this novel hole-transporting layer outperforms reference materials and protects the perovskite organic cell from air humidity.

In [perovskite solar cells](#), the [perovskite](#) light absorption layer is sandwiched between two charge-transporting layers, which collect the generated holes and electrons and transport them to the electrodes. These charge transportation layers boost the [power conversion efficiency](#) of the [cells](#) and are critical for maintaining air stability.

State-of-the-art hole transporters consist of an [organic material](#) called spiro-OMeTAD. However, to promote smooth charge-carrier mobility, they need hygroscopic additives as dopants, which reduce the stability of the perovskites in humid air.

Yongzhen Wu and colleagues from the East China University of Science and Technology are exploring flat, aromatic, nitrogen-containing compounds called quinoxalines as hole transporters. The scientists prepared two novel quinoxalines that contained additional sulfur-bearing entities called thiophenes. The idea was that the energy levels of the thiophene-containing structures matched those of the perovskite layer and enabled efficient hole extraction.

In one of the quinoxalines, the thiophenes were able to rotate more or less freely, while in the other one, the thiophenes were fused and could not rotate. Both quinoxalines formed thin, crystalline films, which were good hole extractors, but only those with the fused thiophene rings also formed well-stacked crystalline layers.

The scientists observed over 21% power conversion efficiency for perovskite solar cells containing the novel hole-transporting material. These cells outperformed reference cells containing the doped spiro-OMeTAD.

The authors also found that the devices made with the new material were more durable than those containing the doped [reference materials](#). The dopant-free devices "maintained a dark and uniform shiny appearance

within 30 days," the scientists wrote, whereas the doped spiro-OMeTAD-containing devices "apparently faded."

The quinoxaline-containing perovskite solar cells also resisted humid air, whereas the performance of the reference cells declined fast. The researchers concluded that the novel material not only enables, hole extraction and transportation, but it also protects the perovskite-based solar cell from moisture.

More information: Huanxin Guo et al. A Coplanar π -Extended Quinoxaline Based Hole-Transporting Material Enabling over 21% Efficiency for Dopant-Free Perovskite Solar Cells, *Angewandte Chemie International Edition* (2020). [DOI: 10.1002/anie.202013128](https://doi.org/10.1002/anie.202013128)

Provided by Wiley

Citation: Dopant-free, humidity-stable organic layers give perovskite solar cells 21% efficiency (2021, January 18) retrieved 19 September 2024 from <https://phys.org/news/2021-01-dopant-free-humidity-stable-layers-perovskite-solar.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.