Using Ammonia to Heal Perovskite Film for Solar Panel Construction

Since 2009, scientists have expected perovskite films, a combination of organic and inorganic materials, to be promising for solar panel construction. By contrast with silicon cells, perovskites are thin films with a specific crystal structure that are light, flexible, efficient, and cost-effective, and they do not require extremely high temperatures for production. However, the fabrication of highly uniform perovskite films at large scales is still a daunting task.

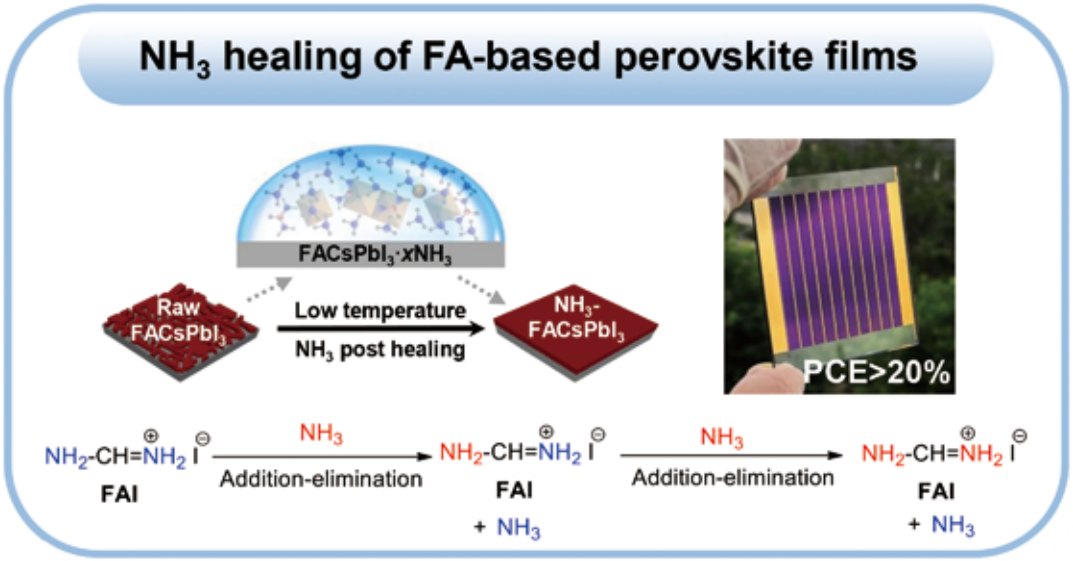
In a paper published in *Nature Communications* on July 29, researchers described a new way of processing formamidinium-based perovskite films using ammonia treatment to remove pore structures formed during the processing. This method can produce highly uniform, compact perovskite films and allows large-scale fabrication.

"The highest power conversion efficiency of perovskite solar cells is comparable to that of widely commercialized silicon-based solar cells. However, how to achieve large-area preparation of highly uniform perovskite film remains a challenge," said Prof. PANG Shuping from Qingdao Institute of Bioenergy and Bioprocess Technology(QIBEBT), Chinese Academy of Sciences(CAS), one of the corresponding authors of the study.

Previous attempts have shown that forming a highly uniform perovskite film requires the participation of additives or an additional step. Although methylamine gas healing can greatly facilitate the process of methylamine-based perovskite films and produce films with few defects, it does not work for formamidinium-based perovskites.

To find solutions to the gas healing of the formamidinium-based perovskite films, the researchers first studied the underlying reactions responsible for the challenges.

"We have shown that the degradation of formamidinium-containing perovskites is caused by a



Ammonia healing of formamidinium-based Perovskite films. (Image by LI Zhipeng)

reaction of the cation in formamidinium and aliphatic amines, producing ammonia," said WANG Xiao, the second author of the study.

To overcome this side effect, researchers used ammonia instead of methylamine gas to treat formamidinium-based perovskite films. By doing so, they can lower the reaction temperature so that the perovskite film can absorb enough ammonia to transform the films into a flowable intermediate state, allowing the defects in raw films to be healed.

Therefore, researchers obtained perovskite films with a higher power conversion efficiency, and they can readily scale up the fabrication. "The perovskite solar cell based on ammonia post healing achieves a power conversion efficiency of 23.21% with excellent reproducibility," said LI Zhipeng, the first author of the study. "An additional bonus of using ammonia gas post healing technology is that it can easily blend into the existing commercial technologies."

Researchers are considering how to properly design the equipment required to produce the perovskite films using this method, which is a key component for bringing perovskite solar cells to the commercial market.

Contact:

CHENG Jing
Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences
E-mail: chengjing@qibebt.ac.cn

(Text by Dr. PANG Shuping, QIBEBT)

Reference

Li, Z., Wang, X., Wang, Z., et al. (2022). Ammonia for post-healing of formamidinium-based Perovskite films. *Nat Commun, 13*(1), 4417. doi:10.1038/s41467-022-32047-z