

# Energy & Environmental Science

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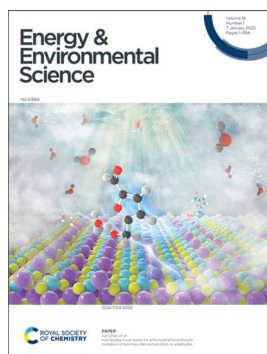
## IN THIS ISSUE

ISSN 1754-5706 CODEN EESNBY 18(1) 1-494 (2025)



### Cover

See Fengqi You *et al.*, pp. 194–213. Image reproduced by permission of Fengqi You and Ehsan Faridi from *Energy Environ. Sci.*, 2025, 18, 194.



### Inside cover

See Jun Zhao *et al.*, pp. 214–226. Image reproduced by permission of Jun Zhao from *Energy Environ. Sci.*, 2025, 18, 214.

## OPINION

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### Payback trade-offs from the electrolyte design between energy efficiency and lifespan in zinc-ion batteries

Xuan Gao, Haobo Dong, Chang Su, Yuhang Dai, Yiyang Liu, Ivan P. Parkin, Claire J. Carmalt\* and Guanjie He\*



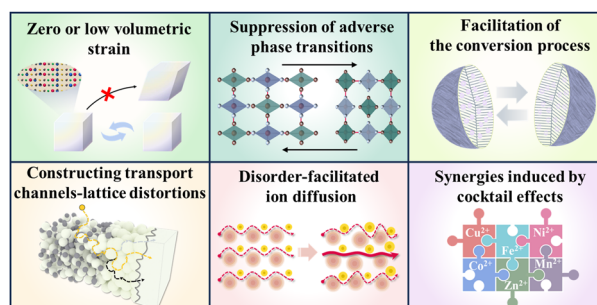
The market-driven development path of aqueous zinc-ion batteries must balance energy efficiency and cycle lifespan

## REVIEWS

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### Improving upon rechargeable battery technologies: on the role of high-entropy effects

Zihao Zhou, Yuan Ma,\* Torsten Brezesinski, Ben Breitung, Yuping Wu\* and Yanjiao Ma\*



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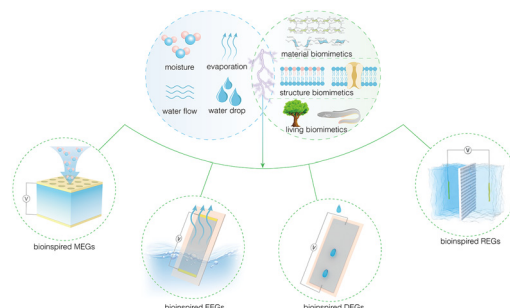


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## Emerging bioinspired hydrovoltaic electricity generators

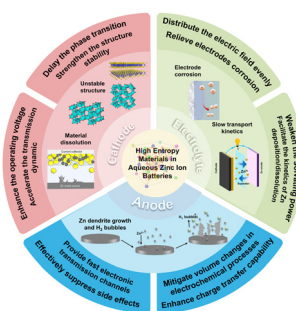
Guangtao Zan, Shengyou Li, Kaiying Zhao, HoYeon Kim, EunAe Shin, Kyuho Lee, Jihye Jang, Gwanho Kim, Yeonji Kim, Wei Jiang, Taebin Kim, Woojoong Kim and Cheolmin Park\*



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## High-entropy materials for aqueous zinc metal batteries

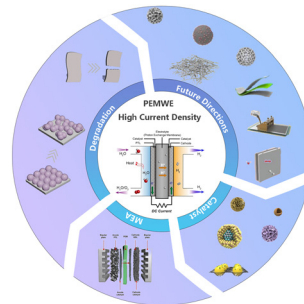
Xiaomin Han, Ran Zhao,\* Jingjing Yang, Yahui Wang, Anqi Zhang, Zhifan Hu, Mengge Lv, Chuan Wu\* and Ying Bai\*



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## Engineering Ir-based catalysts for high current density applications in proton exchange membrane water electrolyzers

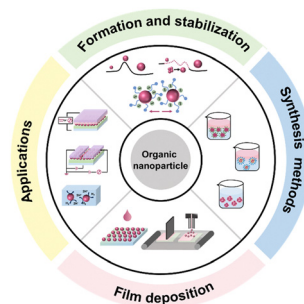
Yang Song, Hongwu Chen, Xingdong Wang, Chenchen Weng, Kang Zou, Cheng Wang, Yanxia Yuan, Yuxuan Ma, Xue Yang\* and Wei Lin\*



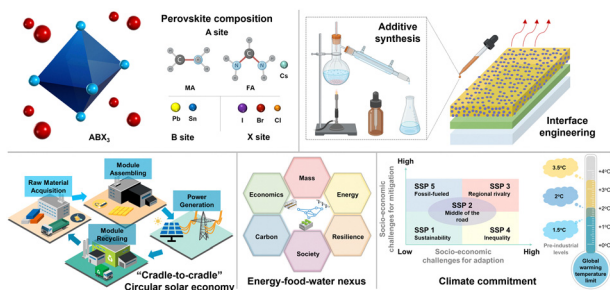
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## A review on organic nanoparticle-based optoelectronic devices: from synthesis to applications

Zhe Liu, Chen Xie, Thomas Heumueller, Iain McCulloch, Christoph J. Brabec, Fei Huang, Yong Cao and Ning Li\*



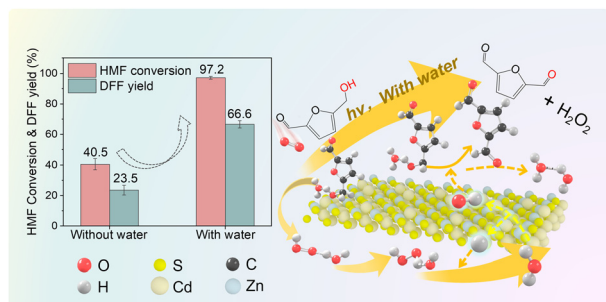
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## Perspectives for sustainability analysis of scalable perovskite photovoltaics

Xueyu Tian, Samuel D. Stranks, Jinsong Huang, Vasilis M. Fthenakis, Yang Yang and Fengqi You\*

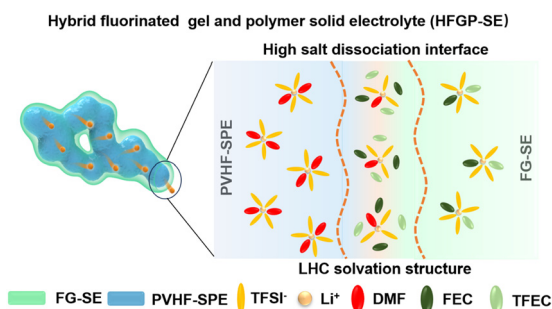
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## Harnessing trace water for enhanced photocatalytic oxidation of biomass-derived alcohols to aldehydes

Wenhua Xue, Jian Ye, Zhi Zhu, Reeti Kumar and Jun Zhao\*

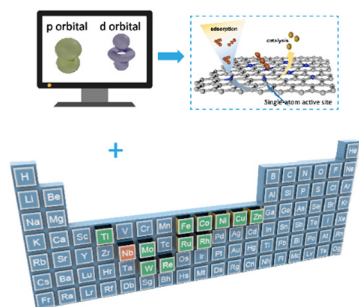
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## Salt dissociation and localized high-concentration solvation at the interface of a fluorinated gel and polymer solid electrolyte

Dechao Zhang, Yuxuan Liu, Dedi Li, Shimei Li, Qi Xiong, Zhaodong Huang, Shixun Wang, Hu Hong, Jiaxiong Zhu, Haiming Lv\* and Chunyi Zhi\*

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## Theoretical calculation-driven rational screening of d-block single-atom electrocatalysts based on d-p orbital hybridization for durable aqueous zinc-iodine batteries

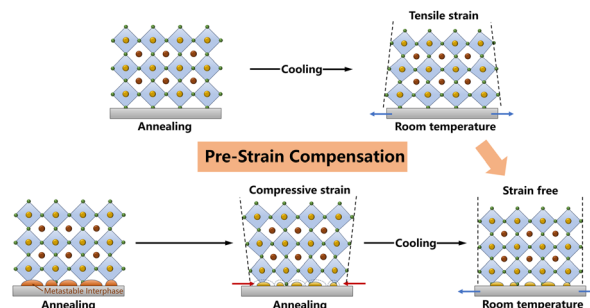
Jin Yang, Yuanhong Kang, Fanxiang Meng, Weiwei Meng, Guanhong Chen, Minghao Zhang, Zeheng Lv, Zhipeng Wen, Cheng Chao Li,\* Jinbao Zhao\* and Yang Yang\*



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## Metastable interphase induced pre-strain compensation enables efficient and stable perovskite solar cells

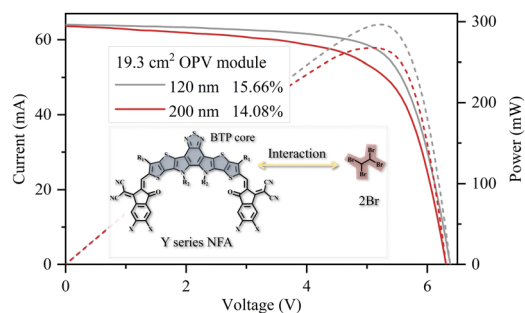
Hongyu Xu, Yun Xiao,\* Karim A. Elmestekawy, Pietro Caprioglio, Qiuyang Li, Qixuan Zhong, Yongqiang Ji, Tianyu Huang, Haoming Yan, Yingguo Yang, Laura M. Herz, Qihuang Gong, Henry J. Snaith,\* Rui Zhu\* and Lichen Zhao\*



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## Simultaneously improving the efficiencies of organic photovoltaic devices and modules by finely manipulating the aggregation behaviors of Y-series molecules

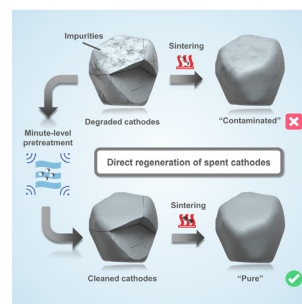
Yaohui Li, Ziyang Jia, Peihao Huang, Chuanlin Gao, Yufei Wang,\* Shuangxi Xue, Shirong Lu\* and Yang (Michael) Yang\*



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## Removal of residual contaminants by minute-level washing facilitates the direct regeneration of spent cathodes from retired EV Li-ion batteries

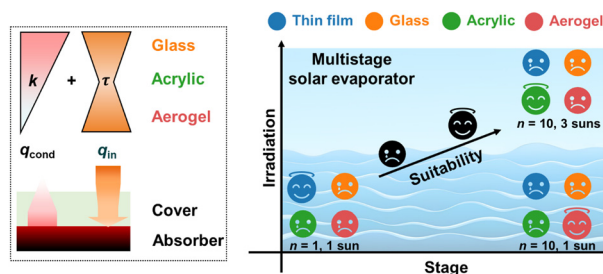
Yi Guo, Yang Li, Kai Qiu, Yan Li, Weijing Yuan, Chenxi Li, Xinyu Rui, Lewei Shi, Yukun Hou, Saiyue Liu, Dongsheng Ren,\* Tiening Tan,\* Gaolong Zhu, Languang Lu, Shengming Xu, Biao Deng, Xiang Liu\* and Minggao Ouyang\*



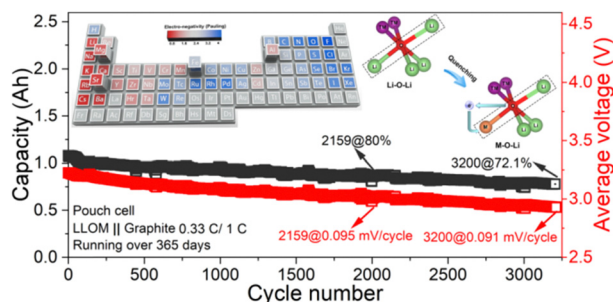
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## Cover matters: enhanced performance of a multistage solar evaporator with tuned optical and thermal cover properties

Shiteng Li, Shang Liu, Qijun Yang, Shuai Deng and Meng Lin\*



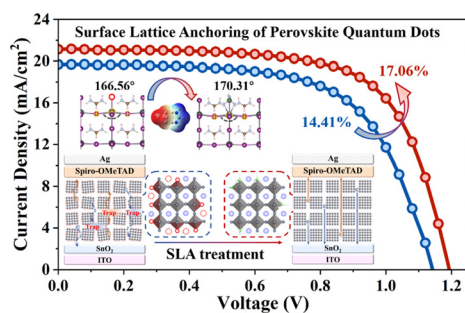
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### Quenching-induced lattice modifications endowing Li-rich layered cathodes with ultralow voltage decay and long life

Lingcai Zeng, Haoyan Liang, Yaqian Wang, Xiaolong Ying, Bao Qiu,\* Jiajie Pan, Yibin Zhang, Wen Wen, Xuechun Wang, Qingwen Gu, Junhao Li, Kaixiang Shi, Yanbin Shen, Quanbing Liu\* and Zhaoping Liu\*

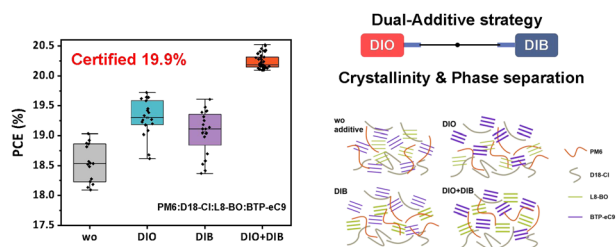
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### Suppressed surface lattice vacancies and distortion through lattice anchoring for efficient FAPbI<sub>3</sub> perovskite quantum dot solar cells

Mingxu Zhang, Xinyi Mei, Guoliang Wang, Junming Qiu, Zhimei Sun\* and Xiaoliang Zhang\*

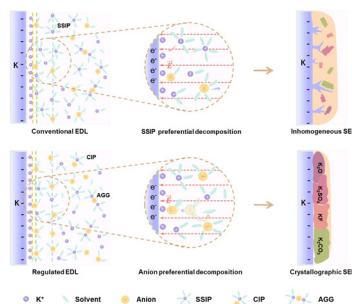
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### Fine-tuning the hierarchical morphology of multi-component organic photovoltaics via a dual-additive strategy for 20.5% efficiency

Shitao Guan, Yaokai Li, ZhaoZhao Bi, Yi Lin, Yuang Fu, Kangwei Wang, Mengting Wang, Wei Ma, Jianlong Xia, Zaifei Ma, Zheng Tang, Xinhui Lu, Lijian Zuo,\* Hanying Li and Hongzheng Chen\*

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### An electric double layer regulator empowers a robust solid–electrolyte interphase for potassium metal batteries

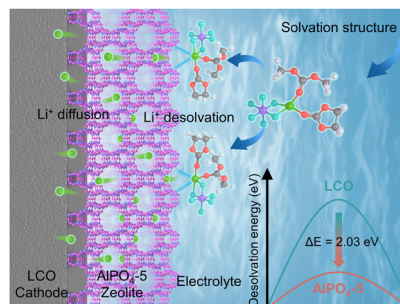
Xueyu Lian, Liang Xu, Zhijin Ju, Ziang Chen, Xiaopeng Chen, Yuyang Yi, Zhengnan Tian, Tao Cheng,\* Shixue Dou, Xinyong Tao\* and Jingyu Sun\*



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### A multifunctional zeolite film enables stable high-voltage operation of a LiCoO<sub>2</sub> cathode

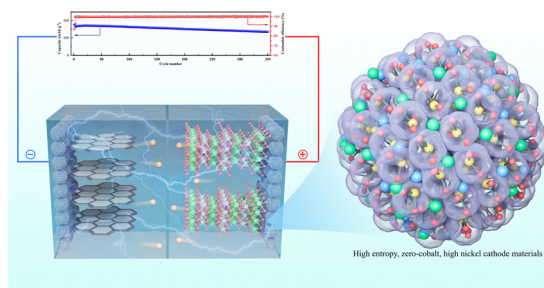
Zezhou Lin, Yiran Ying, Zhihang Xu, Gao Chen, Xi Gong, Zehua Wang, Daqin Guan, Leqi Zhao, Mingyang Yang, Ke Fan, Tiancheng Liu, Hao Li, Honglei Zhang, Huangxu Li, Xi Zhang, Ye Zhu, Zhonguang Lu, Zongping Shao,\* Peiyu Hou\* and Haitao Huang\*



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### High-entropy doping for high-performance zero-cobalt high-nickel layered cathode materials

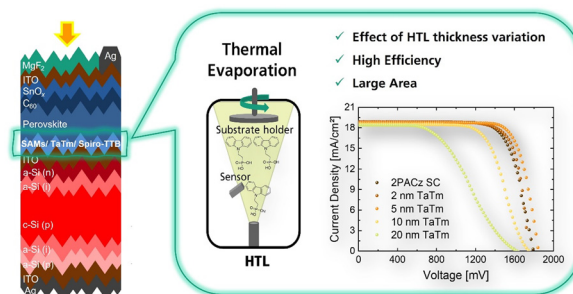
Jiahui Zhou, Jiehui Hu, Xia Zhou, Zhen Shang, Yue Yang\* and Shengming Xu\*



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### Efficient fully textured perovskite silicon tandems with thermally evaporated hole transporting materials

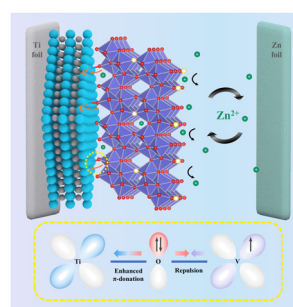
Bhushan P. Kore,\* Oussama Er-raji, Oliver Fischer, Adrian Callies, Oliver Schultz-Wittmann, Patricia S. C. Schulze, Martin Bivour, Stefaan De Wolf, Stefan W. Glunz and Juliane Borchert



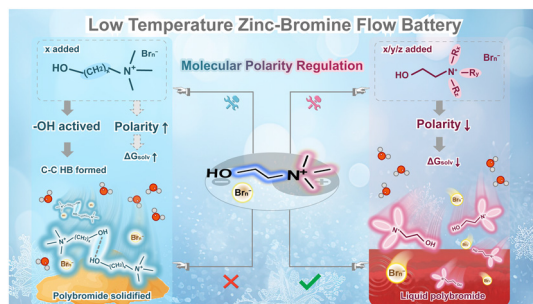
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### Asymmetric orbital hybridization at the MXene–VO<sub>2-x</sub> interface stabilizes oxygen vacancies for enhanced reversibility in aqueous zinc-ion batteries

Yuan Fang, Chunhong Qi, Weichao Bao, Fangfang Xu, Wei Sun,\* Bin Liu, Xiqian Yu, Lianjun Wang, Wan Jiang, Pengpeng Qiu\* and Wei Luo\*



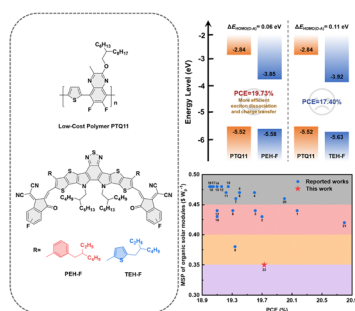
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### Molecular polarity regulation of polybromide complexes for high-performance low-temperature zinc–bromine flow batteries

Ming Zhao, Tao Cheng, Tianyu Li, Shuo Wang, Yanbin Yin\* and Xianfeng Li\*

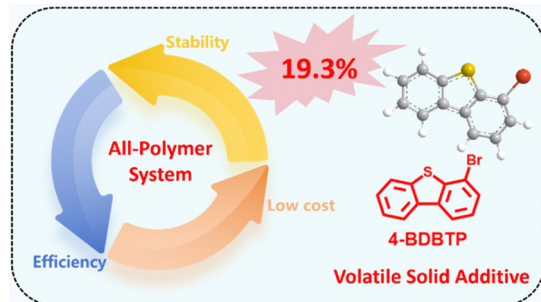
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### Suppressed non-radiative loss and efficient hole transfer at a small highest occupied molecular orbital offset endows binary organic solar cells with 19.73% efficiency and a small efficiency-cost gap

Xiaolei Kong,\* Nana Yang, Xixi Zhang, Jinyuan Zhang, Zhenyu Li, Xinrui Li, Yilei Wu, Rui Sun, Jing Li, Aoxiang Li, Jie Min, Guang Yang and Chenkai Sun\*

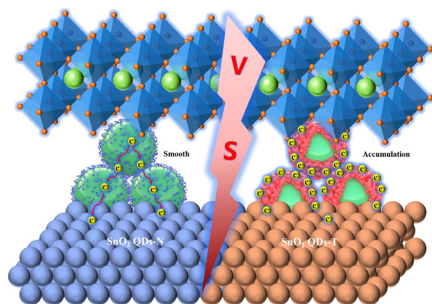
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### Binary all-polymer solar cells with 19.30% efficiency enabled by bromodibenzothiophene-based solid additive

Haisheng Ma, Jiali Song, Jiawei Qiao, Bingyu Han, Qianqian Wang, Min Hun Jee, Laju Bu, Donghui Wei, Han Young Woo, Xiaotao Hao and Yanming Sun\*

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### Surface-deprotonated ultra-small SnO<sub>2</sub> quantum dots for high-performance perovskite solar cells

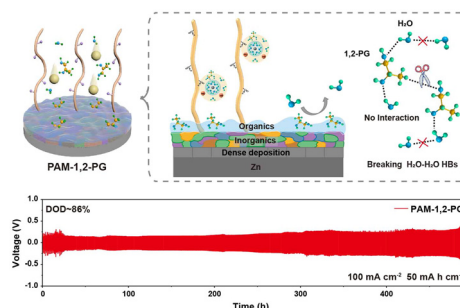
Wuchen Xiang, Yiheng Gao, Bobo Yuan, Shuping Xiao, Rui Wu, Yiran Wan, Zhiqiang Liu, Liang Ma, Xiangbai Chen, Weijun Ke, Guojia Fang and Pingli Qin\*



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## Anti-freezing hydrogel electrolyte with a regulated hydrogen bond network enables high-rate and long cycling zinc batteries

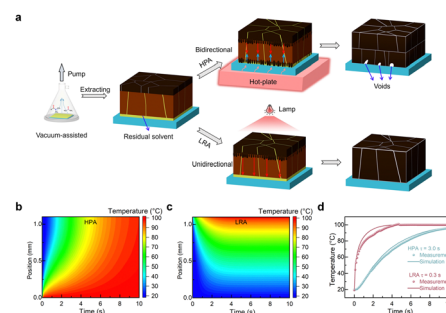
Shao-Jie Guo, Meng-Yu Yan, Dong-Ming Xu, Pan He, Kai-Jian Yan, Jie-Xin Zhu, Yong-Kun Yu, Ze-Ya Peng, Yan-Zhu Luo\* and Fei-Fei Cao\*



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## Light radiation annealing enables unidirectional crystallization of vacuum-assisted Sn–Pb perovskites for efficient tandem solar cells

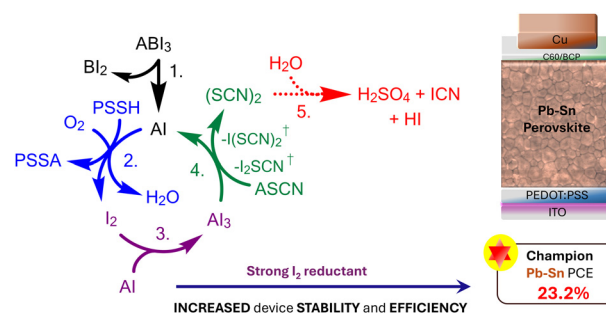
Ciyu Ge, Qi Xu, Dayu Liu, Wenjiang Ye, Yongxin Zhu, Peiyan Zhang, Jiakuan Yang, Guangxing Liang, Ling Xu, Ying Zhou, Haisheng Song, Chao Chen\* and Jiang Tang\*



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## 23.2% efficient low band gap perovskite solar cells with cyanogen management

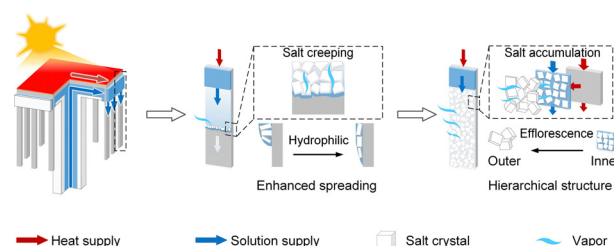
W. Hashini K. Perera, Thomas Webb, Yuliang Xu, Jingwei Zhu, Yundong Zhou, Gustavo F. Trindade, Mateus G. Masteghin, Steven P. Harvey, Sandra Jenatsch, Linjie Dai, Sanjayan Sathasivam, Thomas J. Macdonald, Steven J. Hinder, Yunlong Zhao, Samuel D. Stranks, Dewei Zhao, Wei Zhang, K. D. G. Imalka Jayawardena,\* Saif A. Haque\* and S. Ravi P. Silva\*



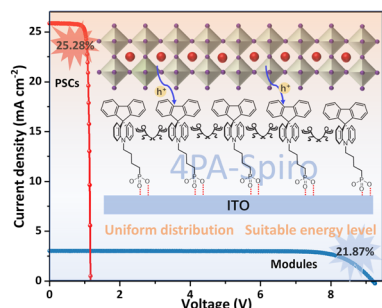
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## Self-assembled porous salt crystals for solar-powered crystallization

Jie Yu, Lenan Zhang, Jintong Gao, Wenyu Han, Ruzhu Wang and Zhenyuan Xu\*



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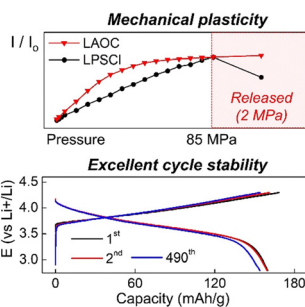
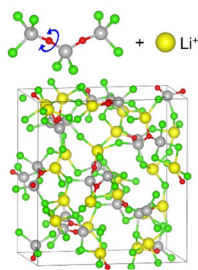


### A spiro-type self-assembled hole transporting monolayer for highly efficient and stable inverted perovskite solar cells and modules

Xianfu Zhang, Botong Li, Shaochen Zhang, Zedong Lin, Mingyuan Han, Xuepeng Liu,\* Jianlin Chen, Weilun Du, Ghadari Rahim, Ying Zhou, Pengju Shi, Rui Wang, Pengfei Wu, Thamraa Alshahrani, Wadha Alqahtani, Norah Alahmad, Qian Wang,\* Bin Ding,\* Songyuan Dai, Mohammad Khaja Nazeeruddin\* and Yong Ding\*

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### Oligomeric solid electrolyte



### A facile route to plastic inorganic electrolytes for all-solid state batteries based on molecular design

Insang You, Baltej Singh, Mengyang Cui, Gillian Goward, Lanting Qian, Zachary Arthur, Graham King and Linda F. Nazar\*

