École polytechnique fédérale de Lausanne (EPFL) Valais/Wallis
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Energypolis, Rue de l'Industrie 17, CH-1950 Sion, Switzerland

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HTM development and surface engineering for efficient and stable PSC

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Despite organic/inorganic lead halide perovskite solar cells becoming one of the most promising next-generation photovoltaic materials, instability under heat and light soaking remains unsolved. In this work, a highly hydrophobic cation, perfluorobenzylammonium iodide (5FBzAI), is designed and a 2D perovskite with reinforced intermolecular interactions is engineered, providing improved passivation at the interface that reduces charge recombination and enhances cell stability compared with benchmark 2D systems. Motivated by the strong halogen bond interaction, (5FBzAI)2PbI4 used as a capping layer aligns in in-plane crystal orientation, inducing a reproducible increase of ≈60 mV in the Voc, a twofold improvement compared with its analogous monofluorinated phenylethylammonium iodide (PEAI) recently reported. This endows the system with high power conversion efficiency of 21.65% and extended operational stability after 1100 h of continuous illumination, outlining directions for future work.[1] Molecularly engineered novel dopant-free hole-transporting materials for perovskite solar cells (PSCs) combined with mixed-perovskite (FAPbI3)0.85(MAPbBr3)0.15 (MA: CH3NH3+, FA: NH=CHNH3+) that exhibit an excellent power conversion efficiency of 18.9% under AM 1.5 conditions are investigated. Additionally, it is found that the maximum power output collected after 1300 h remained 65% of its initial value. This opens up new avenue for efficient and stable PSCs exploring new materials as alternatives to Spiro-Omitted.[2]

References:

[1] Sanghyun Paek, Cristina Roldán-Carmona, Kyung Taek Cho, Marius Franckevičius, Hobeom Kim, Hiroyuke Kanda, Nikita Drigo, Kun-Han Lin, Mingyuan Pei, Rokas Gegevičius, Hyung Joong Yun, Hoichang Yang, Pascal A. Schouwink, Clémence Corminboeuf, Abdullah M. Asiri, Mohammad Khaja Nazeeruddin, "Molecular Design and Operational Stability: Toward Stable 3D/2D Perovskite Interlayers", Adv. Sci. 2020, 7, 2001014

[2] Sanghyun Paek, Peng Qin, Yonghui Lee, Kyung Taek Cho, Peng Gao, Giulia Grancini, Emad Oveisi, Paul Gratia, Kasparas Rakstys, Shaheen A. Al-Muhtaseb, Christian Ludwig, Jaejung Ko, Mohammad Khaja Nazeeruddin, "Dopant-Free Hole-Transporting Materials for Stable and Efficient Perovskite Solar Cells", Adv. Mater. 2017, 1606555

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Born in 1982 in Korea, Sanghyun graduated with a B.S. in Chemistry from the Korea University. He continued his graduate studies at Korea University, the same school, and received his Ph.D degree in 2013. His doctoral thesis focused on Performance Enhancement in Dye-Sensitized Solar Cells and Organic Solar Cells through Molecular Engineering. He worked at EPFL as post-doctoral fellow on the development of novel HTMs and interfacing materials for stable perovskite solar cells. In 2020 he became Assistant Professor at the University of Sangmyuong in Seoul, and has been synthesis new HTM on perovskite solar cells and photocatalyst on hydrogen generation.

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