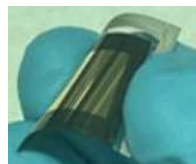


Devices on film substrates

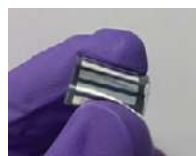


22.37% (中国·電子科技大[成都]) 2022/04/05

PEN / ITO / SnO₂:HCOONH₄ / (FA/MA)PbI₃ / spiro / Au

"Pre-buried additive for cross-layer modification in flexible perovskite solar cells with efficiency exceeding 22%"

Z. Zheng, F. Li, J. Gong, Y. Ma, J. Gu, X. Liu, S. Chen, M. Liu,
Adv. Mater., in press. DOI:10.1002/adma.202109879

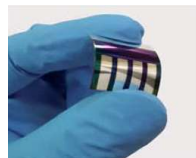


21.73% (中国·香港城市大) 2021/10/03

PEN / ITO / PTAA / Cs_{0.05}(FA_{0.98}MA_{0.02})_{0.95}Pb(I_{0.98}Br_{0.02})₃ / PM6:CH1007:PCBM / Zr(acac)₄ / Ag

"Low-bandgap organic bulk-heterojunction enabled efficient and flexible perovskite solar cells"

S. Wu, Z. Li, J. Zhang, X. Wu, X. Deng, Y. Liu, J. Zhou, C. Zhi, X. Yu, W. C. H. Choy, Z. Zhu, A. K.-Y. Jen,
Adv. Mater. **2021**, 33, 2105539. DOI:10.1002/adma.202105539

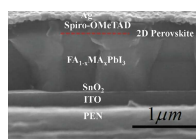


21.10% (中国·廈門大) 2020/12/14

PEN / ITO / HfO_x / SnO₂ / Cs_{0.05}Rb_{0.05}(FA_{0.83}MA_{0.17})_{0.90}Pb(I_{0.95}Br_{0.05})₃ / spiro / MoO_x / Au

"Artemisinin-passivated mixed-cation perovskite films for durable flexible perovskite solar cells with over 21% efficiency"

L. Yang, Q. Xiong, Y. Li, P. Gao, B. Xu, H. Lin, X. Li, T. Miyasaka,
J. Mater. Chem. A **2021**, 9, 1574-1582. DOI:10.1039/d0ta10717d

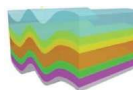


21.1% (中国·中南大[長沙]) 2021/06/26

PEN / ITO / SnO₂ / (FA/MA)PbI₃ / spiro / Ag

"Creating a dual-functional 2D perovskite layer at the interface to enhance the performance of flexible perovskite solar cells"

C. Long, K. Huang, J. Chang, C. Zuo, Y. Gao, X. Luo, B. Liu, H. Xie, Z. Chen, J. He, H. Huang, Y. Gao, L. Ding, J. Yang,
Small **2021**, 17, 2102368. DOI:10.1002/smll.202102368



21.02% (中国·香港理工大) 2021/09/22

PET / ITO / PTAA / MAPbI₃ / PCBM / BCP / Ag

"Highly stable and efficient perovskite solar cells passivated by a functional amorphous layer"

G. Tang, T. Wang, J. Cao, Z. Zhao, J. Song, P. Liu, H. Cheng, F. Zheng, J. Zhao, F. Yan,
J. Mater. Chem. A **2021**, 9, 21708-21715. DOI:10.1039/d1ta07505e



21.0% (中国·大連理工大 & 米国ブラウン大 & スイスEPFL) 2021/05/25

PET / ITO / SnO₂ / (CsPbI₃)_{0.04}[(FAPbI₃)_{0.9}(MAPbBr₃)_{0.1}]_{0.96} / spiro / Au

"Flexible perovskite solar cells with simultaneously improved efficiency, operational stability, and mechanical reliability"

Q. Dong, M. Chen, Y. Liu, F. T. Eickemeyer, W. Zhao, Z. Dai, Y. Yin, C. Jiang, J. Feng, S. Jin, S. F. Liu, S. M. Zakeeruddin,
M. Grätzel, N. P. Padture, Y. Shi, *Joule* **2021**, 5, 1587-1601. DOI:10.1016/j.joule.2021.04.014

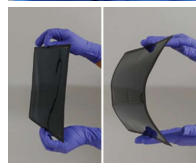


20.87% (中国·南開大[天津]) 2021/02/02

PET / ITO / SnO₂ / Al(acac)₃ / (FA/MA)PbI₃ / spiro / Au

"Humidity-resistant flexible perovskite solar cells with over 20% efficiency"

N. Ren, B. Chen, R. Li, P. Wang, S. Mazumdar, B. Shi, C. Zhu, Y. Zhao, X. Zhang,
Solar RRL **2021**, 5, 2000795. DOI:10.1002/solr.202000795



20.75% (韓国·KRICT) 2020/10/22 【19.91% by Newport】

PEN / ITO / SnO₂ / Zn₂SnO₄ / (FAPbI₃)_{0.95}(MAPbBr₃)_{0.05} / spiro / Au

"Record-efficiency flexible perovskite solar cell and module enabled by a porous-planar structure as an electron transport layer"

J. Chung, S. S. Shin, K. Hwang, G. Kim, K. W. Kim, D. S. Lee, W. Kim, B. S. Ma, Y.-K. Kim, T.-S. Kim, J. Seo,
Energy Environ. Sci. **2020**, 13, 4854-4861. DOI:10.1039/d0ee02164d



20.50% (中国·吉林大) 2021/12/29

PEN / ITO / PTAA / (FA/MA)PbI₃ / C₆₀ / BCP / Cu

"Thermal dynamic self-healing supramolecular dopant towards efficient and stable flexible perovskite solar cells"

C. Ge, X. Liu, Z. Yang, H. Li, W. Niu, X. Liu, Q. Dong,
Angew. Chem. Int. Ed. **2022**, 61, e202116602. DOI:10.1002/anie.202116602

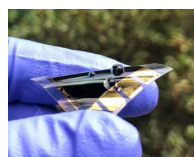


20.40% (中国·厦門大) 2020/04/28

PEN / ITO / SnO₂ / Cs_{0.05}Rb_{0.05}(FA_{0.83}MA_{0.17})_{0.90}Pb(I_{0.95}Br_{0.05})₃ / spiro / Ag

"Exfoliated fluorographene quantum dots as outstanding passivants for improved flexible perovskite solar cells"

L. Yang, Y. Li, L. Wang, Y. Pei, Z. Wang, Y. Zhang, H. Lin, X. Li,
ACS Appl. Mater. Interfaces **2020**, 12, 22992-23001. DOI:10.1021/acsami.0c04975

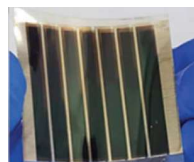


20.4% (韩国·KRICT) 2021/01/04

PET / ITO / SnO₂ / (FAPbI₃)_{0.95}(MAPbBr₃)_{0.05} / spiro / Au

"Highly efficient and stable flexible perovskite solar cells enabled by using plasma-polymerized-fluorocarbon antireflection layer"

E. Cho, Y. Y. Kim, D. S. Ham, J. H. Lee, J.-S. Park, J. Seo, S.-J. Lee,
Nano Energy **2021**, 82, 105737. DOI:10.1016/j.nanoen.2020.105737



20.16% (中国·暨南大[广州]) 2021/10/08

PEN / ITO / PEDOT:PSS / PTAA / Cs_{0.05}FA_{0.7}MA_{0.25}Pb(I_{0.93}Br_{0.07})₃ / PCBM / BCP / Ag

"An embedding 2D/3D heterostructure enables high-performance FA-alloyed flexible perovskite solar cells with efficiency over 20%"

Z. Wang, Y. Lu, Z. Xu, J. Hu, Y. Chen, C. Zhang, Y. Wang, F. Guo, Y. Mai,
Adv. Sci. **2021**, 8, 2101856. DOI:10.1002/advs.202101856

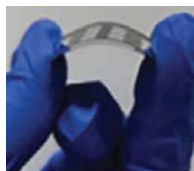


20.1% (中国·大連理工大 & 米国ブラウン大) 2021/02/12

PEN / ITO / SnO₂ / Cs_{0.04}(FA_{0.84}MA_{0.16})_{0.96}Pb(I_{0.84}Br_{0.16})₃ / spiro / Au

"Interpenetrating interfaces for efficient perovskite solar cells with high operational stability and mechanical robustness"

Q. Dong, C. Zhu, M. Chen, C. Jiang, J. Guo, Y. Feng, Z. Dai, S. K. Yadavalli, M. Hu, X. Cao, Y. Li, Y. Huang, Z. Liu, Y. Shi,
L. Wang, N. P. Padture, Y. Zhou, *Nature Commun.* **2021**, 12, 973. DOI:10.1038/s41467-021-21292-3



20.09% (中国·河南師範大) 2022/02/25

PEN / ITO / SnO₂ / Y6 acceptor / Cs_{0.05}(FA_{0.87}MA_{0.13})_{0.95}Pb(I_{0.87}Br_{0.13})₃ / spiro / MoO₃ / Au

"Semi-planar non-fullerene molecules enhance the durability of flexible perovskite solar cells"

H. Liu, Z. Zhang, Z. Su, W. Zuo, Y. Tang, F. Yang, X. Zhang, C. Qin, J. Yang, Z. Li, M. Li,
Adv. Sci., in press. DOI:10.1002/advs.202105739

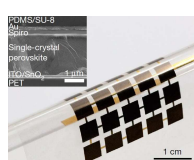


20.07% (中国·北京大) 2022/01/06

PEN / ITO / SnO₂ / (FA/MA)PbI₃ / spiro / Au

"Facet orientation tailoring via 2D-seed-induced growth enables highly efficient and stable perovskite solar cells"

C. Luo, G. Zheng, F. Gao, X. Wang, Y. Zhao, X. Gao, Q. Zhao,
Joule **2022**, 6, 240-257. DOI:10.1016/j.joule.2021.12.006

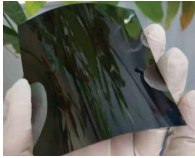


20.04% (米国UC San Diego) 2020/07/29

PET / ITO / SnO₂ / MA(Sn/Pb)I₃ / spiro / Au / PDMS/SU-8

"A fabrication process for flexible single-crystal perovskite devices"

Y. Lei, Y. Chen, R. Zhang, Y. Li, Q. Yan, S. Lee, Y. Yu, H. Tsai, W. Choi, K. Wang, Y. Luo, Y. Gu, X. Zheng, C. Wang, C. Wang,
H. Hu, Y. Li, B. Qi, M. Lin, Z. Zhang, S. A. Dayeh, M. Pharr, D. P. Fenning, Y.-H. Lo, J. Luo, K. Yang, J. Yoo, W. Nie, S. Xu,
Nature **2020**, 583, 790-795. DOI:10.1038/s41586-020-2526-z



20.01% (中国·上海交通大) 2020/01/30

PET / ITO / $\text{NiO}_x\text{:F}_2\text{HCNQ}$ / $(\text{Cs/FA/MA})\text{Pb}(\text{I/Br})_3$ / PCBM / BCP / Ag

"High electron affinity enables fast hole extraction for efficient flexible inverted perovskite solar cells"

P. Ru, E. Bi, Y. Zhang, Y. Wang, W. Kong, Y. Sha, W. Tang, P. Zhang, Y. Wu, W. Chen, X. Yang, H. Chen, L. Han, *Adv. Energy Mater.* **2020**, *10*, 1903487. DOI:10.1002/aenm.201903487



20.00% (中国·中物院四川材料研) 2021/07/17

PEN / ITO / $\text{SnO}_2\text{/NbO}_x$ / $(\text{FA/MA})\text{Pb}(\text{I/Cl})_3$ / spiro / Au

"Boosted charge extraction of NbO_x -enveloped SnO_2 nanocrystals enable 24% efficient planar perovskite solar cells"

R. Yuan, B. Cai, Y. Lv, X. Gao, J. Gu, Z. Fan, X. Liu, C. Yang, M. Liu, W.-H. Zhang, *Energy Environ. Sci.* **2021**, *14*, 5074-5083. DOI:10.1039/d1ee01519b

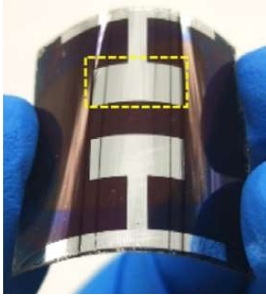


20.00% (中国·吉林大) 2020/10/12

PEN / ITO / PTAA / PFN-Br / $\text{Cs}_{0.05}(\text{FA}_{0.87}\text{MA}_{0.13})_{0.95}\text{Pb}(\text{I}_{0.87}\text{Br}_{0.13})_3$ / C_{60} / BCP / Cu

"Stable and highly flexible perovskite solar cells with power conversion efficiency approaching 20% by elastic grain boundary encapsulation", C. Ge, Z. Yang, X. Liu, Y. Song, A. Wang, Q. Dong

CCS Chem. **2020**, *2*, 2035-2044. DOI:10.31635/ccschem.020.202000335



20.56%@1.01cm² (中国·南昌大) 2020/11/03

PET / hc-PEDOT:PSS / NiO_x / (FA/MA)Pb(I/Br)₃:s-GO:PU [meniscus-coat] / PCBM / BCP / Ag

"Cementitious grain-boundary passivation for flexible perovskite solar cells with superior environmental stability and mechanical robustness", X. Hu, X. Meng, X. Yang, Z. Huang, Z. Xing, P. Li, L. Tan, M. Su, F. Li, Y. Chen, Y. Song, *Sci. Bull.* **2021**, *66*, 527-535. DOI:10.1016/j.scib.2020.10.023



20.29%@1.00cm² (中国·南昌大) 2021/10/13

PET / hc-PEDOT:PSS / PEDOT:EVA / (FA/MA)Pb(I/Br)₃:Di-g [meniscus-coat] / PCBM / BCP / Ag

"A biomimetic self-shield interface for flexible perovskite solar cells with negligible lead leakage"
X. Meng, X. Hu, Y. Zhang, Z. Huang, Z. Xing, C. Gong, L. Rao, H. Wang, F. Wang, T. Hu, L. Tan, Y. Song, Y. Chen
Adv. Funct. Mater., in press. DOI:10.1002/adfm.202106460

15.01% for 25 cm² module (17.20% for 21.82 cm² active area)



19.87%@1.01cm² (中国·南昌大) 2020/06/15

PET / ITO / PEDOT:EVA / (FA/MA)Pb(I/Br)₃ [meniscus-coat] / PCBM / BCP / Ag

"Bio-inspired vertebral design for scalable and flexible perovskite solar cells"

X. Meng, Z. Cai, Y. Zhang, X. Hu, Z. Xing, Z. Huang, Z. Huang, Y. Cui, T. Hu, M. Su, X. Liao, L. Zhang, F. Wang, Y. Song, Y. Chen, *Nature Commun.* **2020**, *11*, 3016. DOI:10.1038/s41467-020-16831-3

17.55% for 31.2 cm² module (15.21% for 36 cm² aperture area)



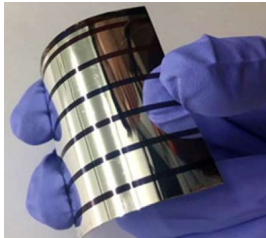
19.87%@1.01cm² (中国科技大 & 南昌大) 2022/01/15

PEN / hc-PEDOT:PSS / NiO_x / MAPbI₃ [meniscus-coat] / PCBM / Ag

"Scalable flexible perovskite solar cells based on a crystalline and printable template with intelligent temperature sensitivity"

X. Yang, H. Yang, M. Su, J. Zhao, X. Meng, X. Hu, T. Xue, Z. Huang, Y. Lu, Y. Li, Z. Yang,
Solar RRL, in press. DOI:10.1002/solr.202100991

14.74% for 25 cm² module



19.7%@1.01cm² (中国·鄭州大 & 南昌大) 2021/04/22

PET / ITO / PEDOT:GO gel / MAPbI₃ [blade-coat] / PCBM / Ag

"Mechanically robust and flexible perovskite solar cells via a printable and gelatinous interface"

T. Xue, G. Chen, X. Hu, M. Su, Z. Huang, X. Meng, Z. Jin, J. Ma, Y. Zhang, Y. Song,
ACS Appl. Mater. Interfaces **2021**, *13*, 19959-19969. DOI:10.1021/acsami.1c00813

10.26% for 25 cm² module