Supporting Information

The Effect of Stoichiometry on the Stability of Inorganic Cesium Lead Mixed-Halide Perovskites Solar Cells

Qingshan Ma[†], Shujuan Huang[,†], Sheng Chen[†], Meng Zhang[†], Cho Fai Jonathan Lau[†], Mark N. Lockrey[‡], Hemant K. Mulmudi[§], Yuchao Shan[⊥], Jizhong Yao[⊥], Jianghui Zheng[†], Xiaofan Deng[†], Kylie Catchpole[§], Martin A. Green[†], Anita W. Y. Ho-Baillie[†]*

[†] Australian Centre for Advanced Photovoltaics, University of New South Wales, Sydney 2052, Australia

[‡] Australian National Fabrication Facility ACT Node, Research School of Physics and Engineering, The Australian National University, Canberra, ACT 2601, Australia

[§] Centre for Sustainable Energy Systems, Research School of Engineering, Australian National University, Canberra, ACT 2601, Australia

[⊥] Microquanta Semiconductor Co., LTD, Hangzhou, 311121, China

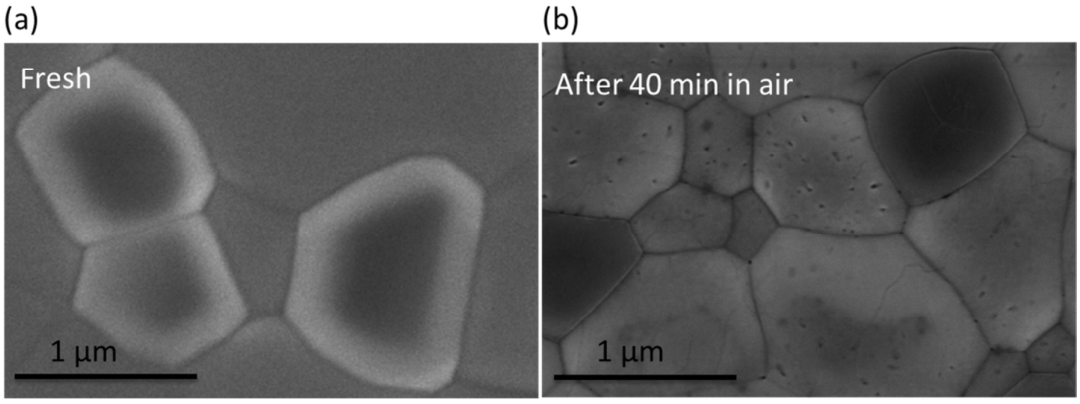


Figure S1. Top view SEM images of (a) fresh and (b) air-exposed PbI_2-rich $CsPbI_2Br$ films. Damages (pinholes) can be seen on the grains after air exposure.

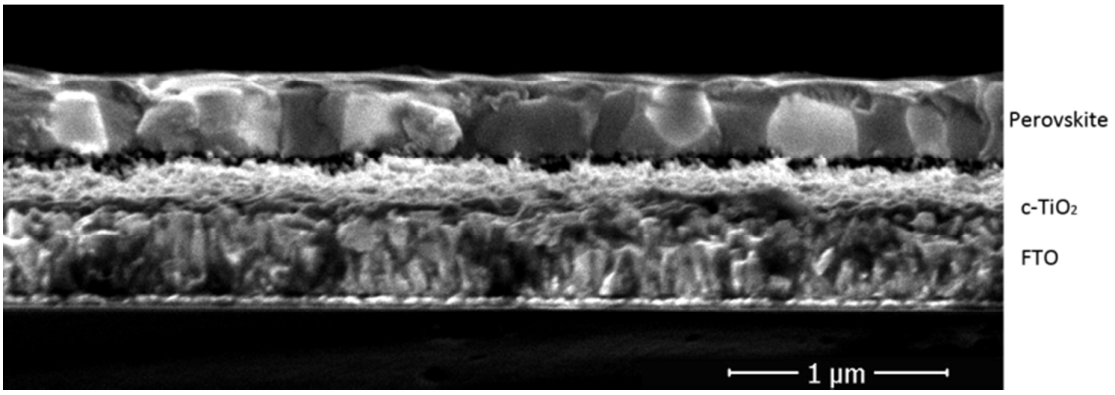
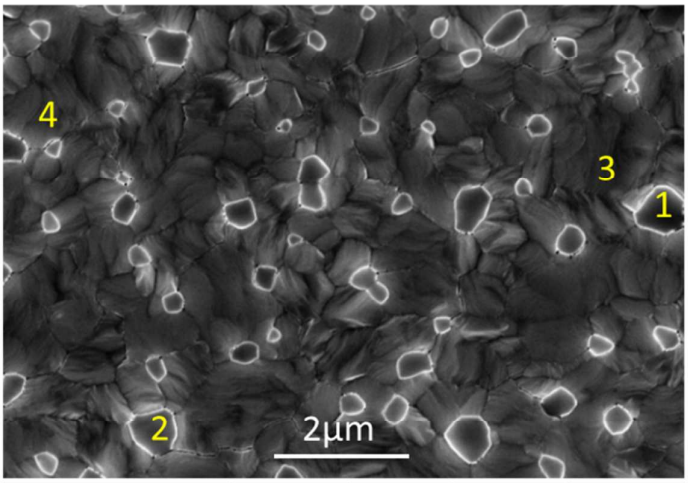


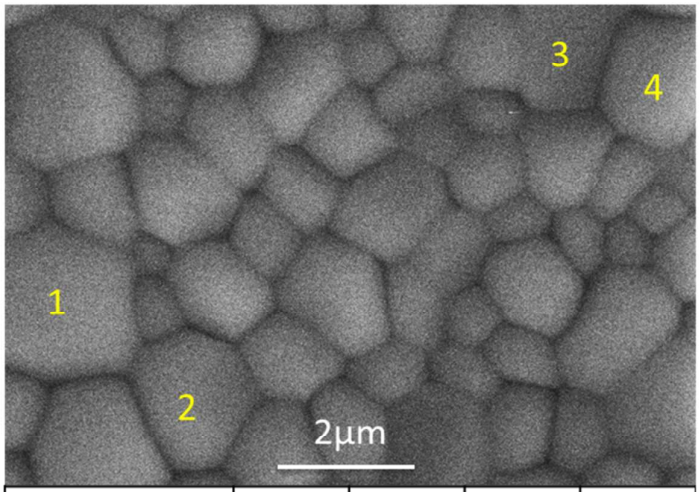
Figure S2. Cross sectional SEM image of CsBr rich $CsPbI_2Br$ on compact TiO_2 and FTO. It can be seen that the brighter impurity grains in the perovskite film are not on the surface, but throughout the film.

(a) CsBr rich



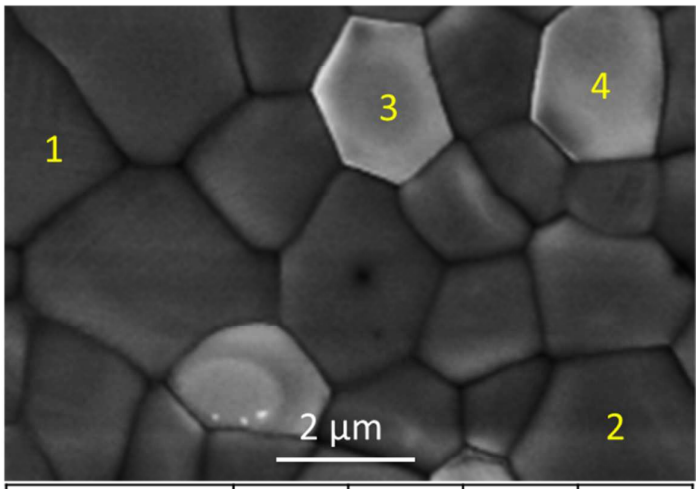
grains	Cs	Pb	I	Br
1	2.65	1	2.35	1.76
2	2.50	1	2.27	1.74
3	1.10	1	1.73	1.01
4	1.12	1	1.73	1.07

(b) Stoichiometry balanced



grains	Cs	Pb	I	Br
1	0.94	1	2.28	1.26
2	0.96	1	2.27	1.29
3	0.96	1	2.36	1.38
4	1.02	1	2.27	1.31

(c) PbI_2 rich



grains	Cs	Pb	I	Br
1	1.09	1	2.03	0.45
2	1.03	1	1.97	0.88
3	0.61	1	1.41	1.08
4	0.56	1	1.39	1.09

Figure S3. EDS point analysis on the (a) CsBr-rich, (b) stoichiometrically balanced and (c) PbI_2-rich $CsPbI_2Br$ films (atomic ratio normalized to Pb element).

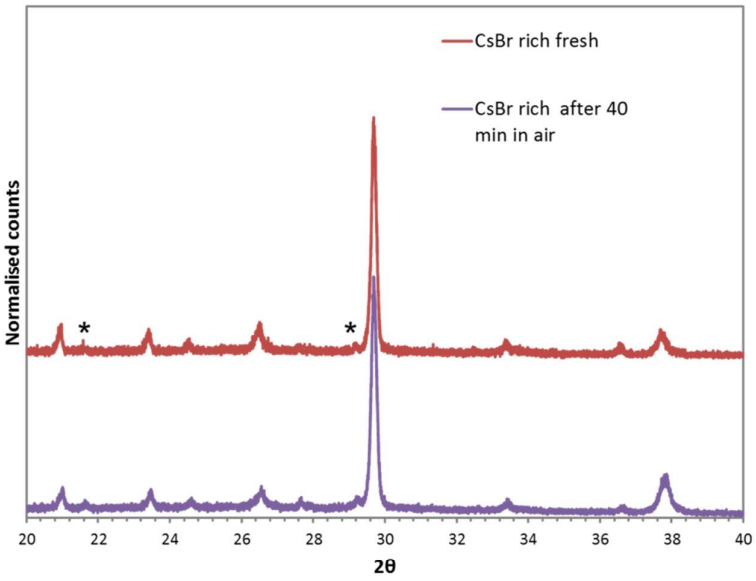


Figure S4. XRD pattern of the fresh and air-exposed CsBr-rich $CsPbI_2Br$ films showing that the (110) peak at 20.95° has a small split peak at 21.58° and the (200) peak at 29.65° has a shoulder peak at 29.22°, as indicated by "*".

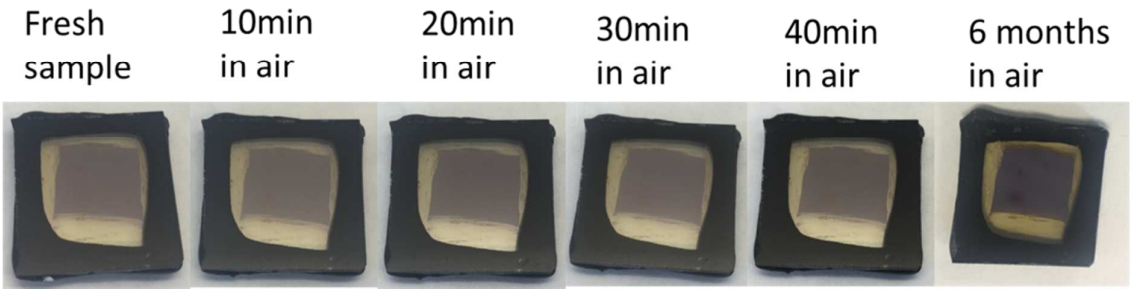


Figure S5. Photos showing the lack of degradation for encapsulated stoichiometrically balanced $CsPbI_2Br$ films upon exposure to air. It can be seen that with encapsulation the colour of the perovskite film remains the same even after 6 months.