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Supporting Information

Enhanced moisture tolerance in efficient hybrid 3D/2D perovskite photovoltaics

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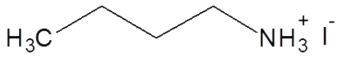
Butylammonium iodide (BAI)



Octylammonium iodide (OAI)

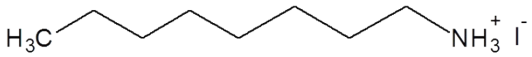


Figure S1. Chemical structures of the alkylammonium salts for forming hybrid 3D/2D perovskites.

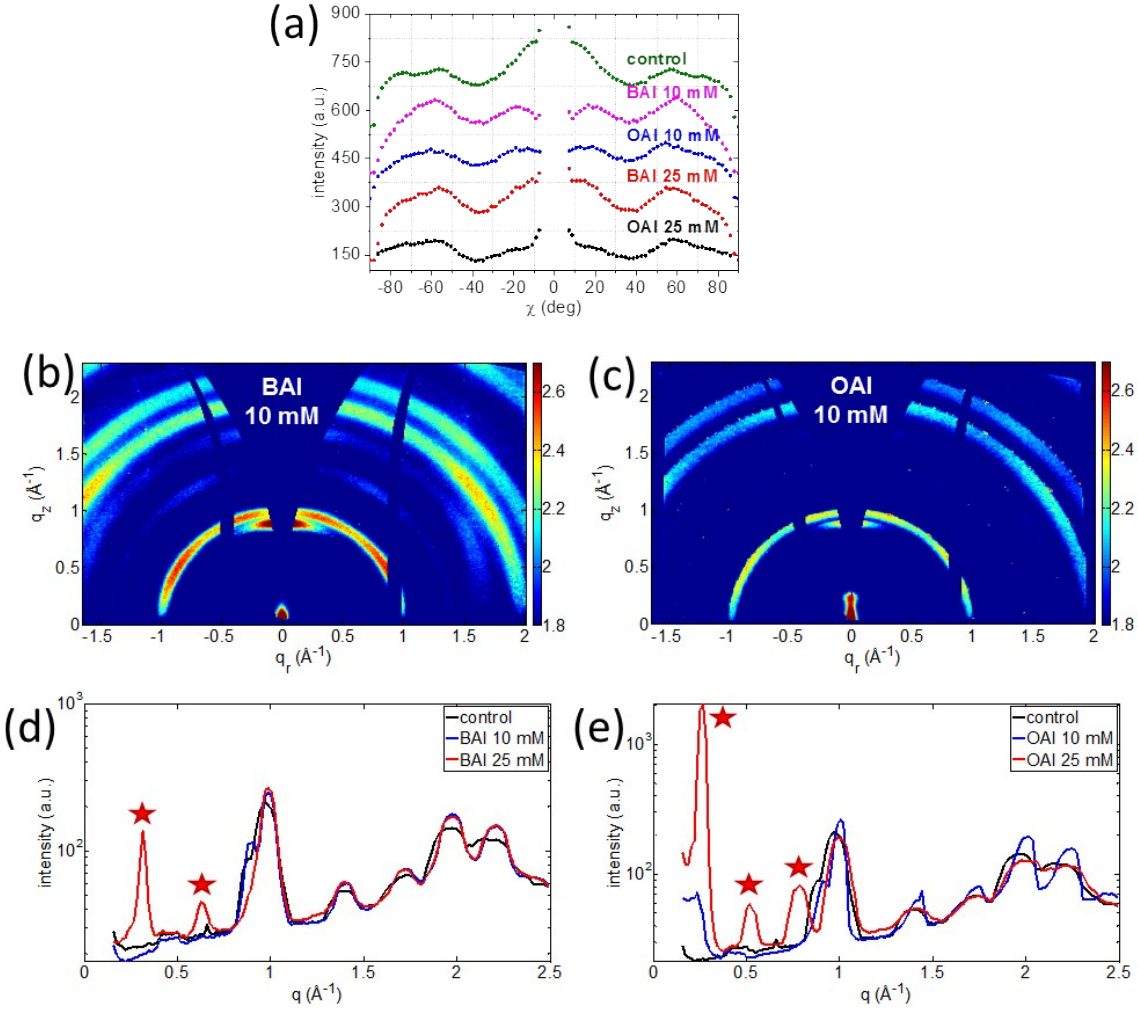


Figure S2. GIWAXS data for the hybrid 3D/2D perovskites. (a) Azimuthally integrated GIWAXS data around q = 1 Å^{-1} for the sample series with inclusion of BAI and OAI, showing distinct changes in the overall crystal orientation of the samples. (b,c) 2D GIWAXS data for the hybrid 3D/2D perovskites after inclusion of BAI and OAI for 10 mM. (d,e) GIWAXS data integrated over q for the sample series with inclusion of BAI and OAI.

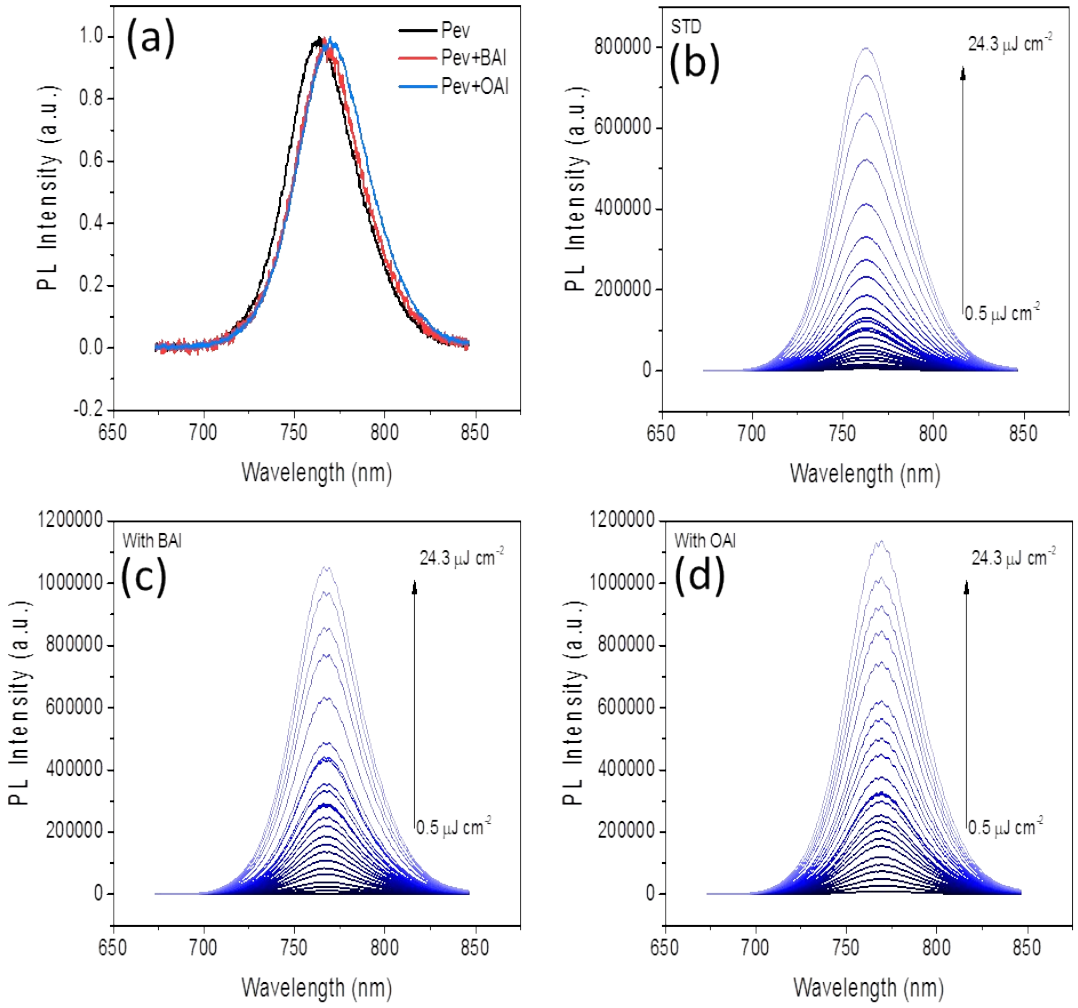


Figure S3. (a) Photoluminescence of the perovskite films (10 mM BAI/OAI for 3D/2D perovskites), indicating no significant shift in the emission peaks. (b-f) power-dependent photoluminescence measurements of perovskite films in the low fluence regime in order to avoid saturation of the traps.

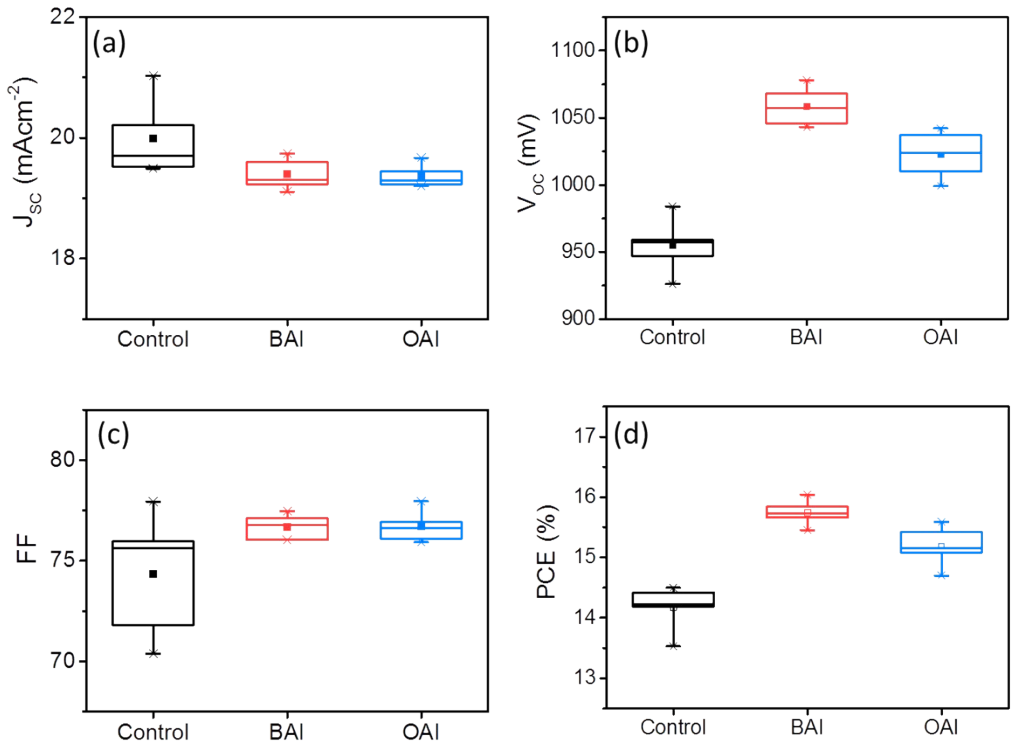


Figure S4. Statistics of *J-V* characteristics of 15 devices of various perovskite solar cells (10 mM BAI/OAI for 3D/2D perovskites).

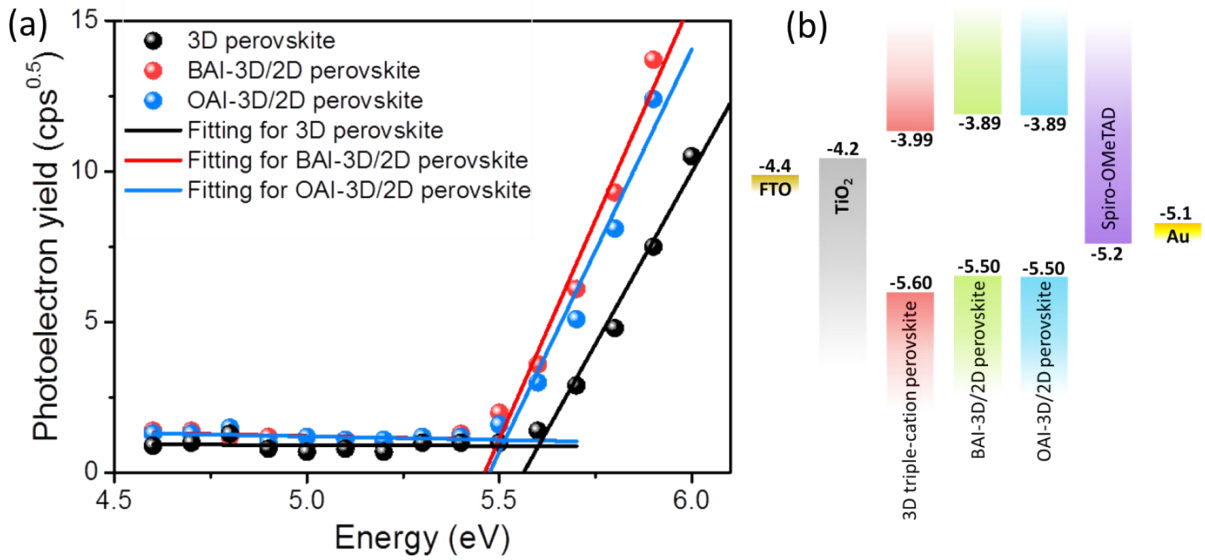


Figure S5. (a) Photoelectron spectroscopy in air (PESA) of different perovskite films (10 mM BAI/OAI for 3D/2D perovskites). (b) Energy diagram of the devices.

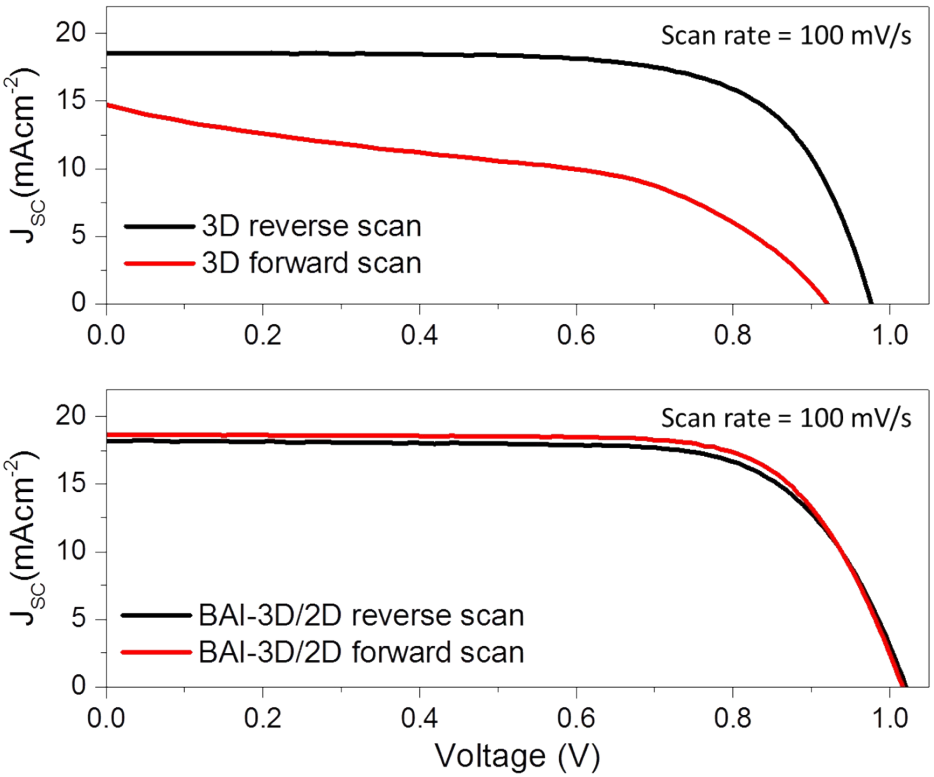


Figure S6. *J-V* characteristics of solar cells fabricated from 3D and hybrid 3D/2D perovskites, recorded in both reverse scanning direction (from V_{OC} to J_{SC}) and forward scanning direction (from J_{SC} to V_{OC}) with sweeping rate of 100 mV/s under AM 1.5G (100 mW cm^{-2}) illumination (mask = 0.09 cm^2).

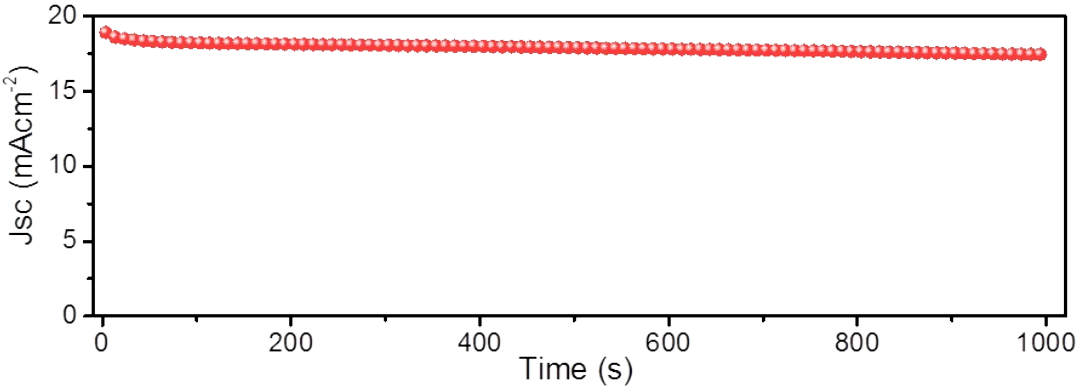


Figure S7. Plot of stabilized photocurrent density (Jsc) as a function of time of unencapsulated BAI-3D/2D perovskite solar cells measured at its maximum power point (0.83V) under illumination for 1000 s.