Supporting info

Development of SnO_2 composites as electron transport layer in un-encapsulated $CH_3NH_3PbI_3$ solar cells

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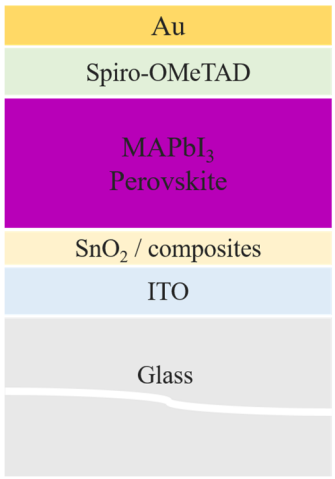
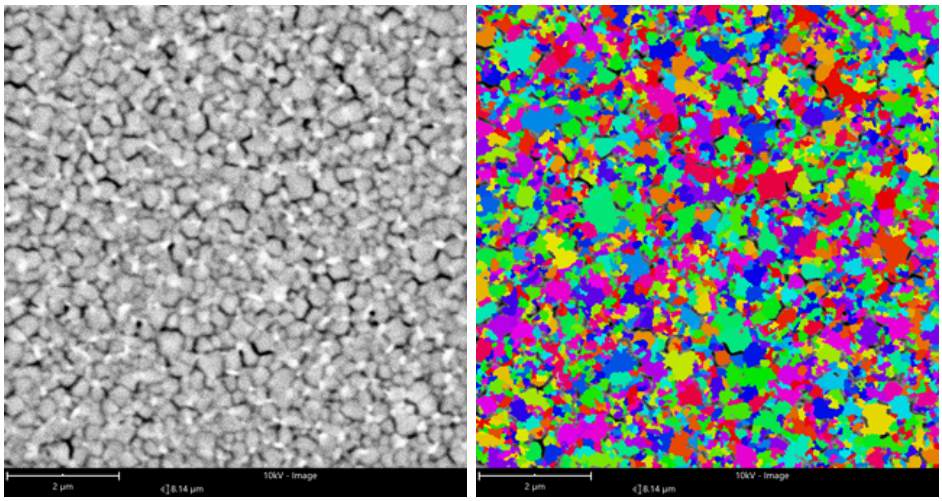


Figure S1. PSC with n-i-p configuration adopted for our devices

a)



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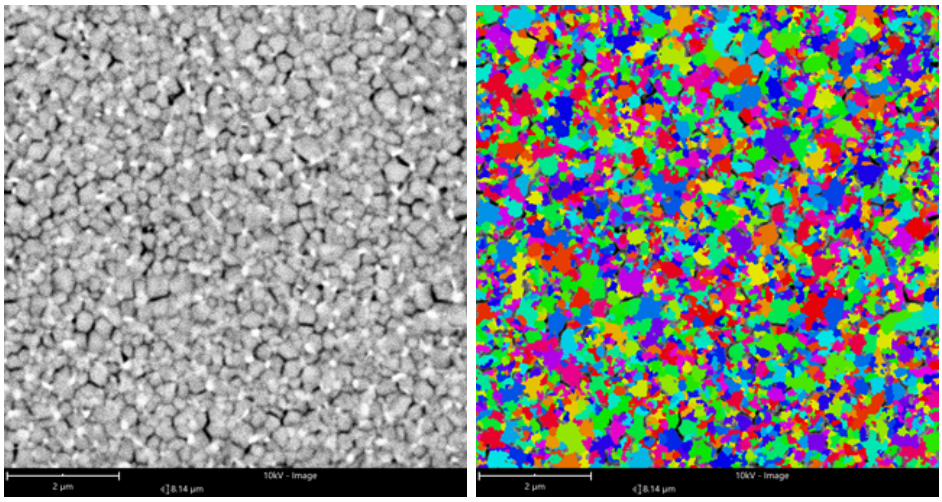

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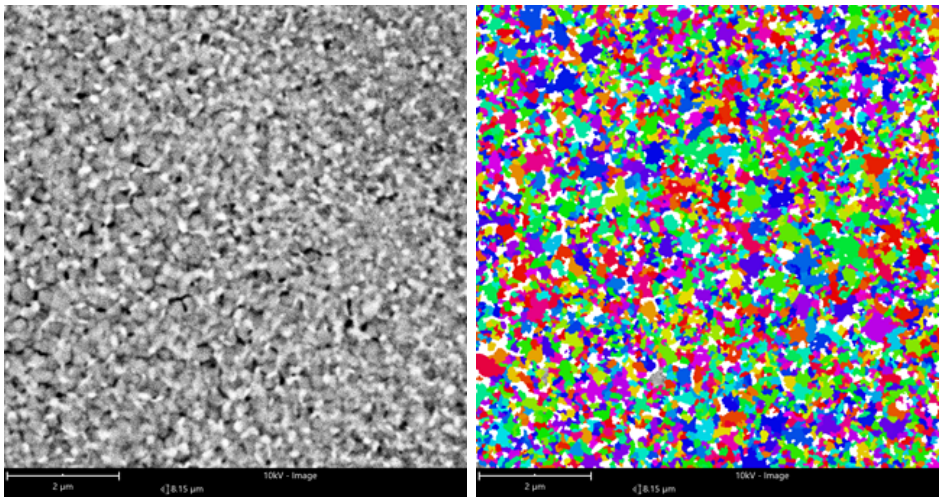

Figure S2. Grain size analysis of $MAPbI_3$ crystals growth on SnO_2 (a), SnO_2:In_2O_3 (b) and SnO_2:ZnO (c) ETLs. Data are shown in Table S1.

Table S1. Average value of perovskite grain sizes weighted by count.

ETL	Area [μm²]	Major axis [nm]	Minor axis [nm]
SnO_2	0.026	236	116
SnO_2:In_2O_3	0.024	216	112
SnO_2:ZnO	0.017	177	99

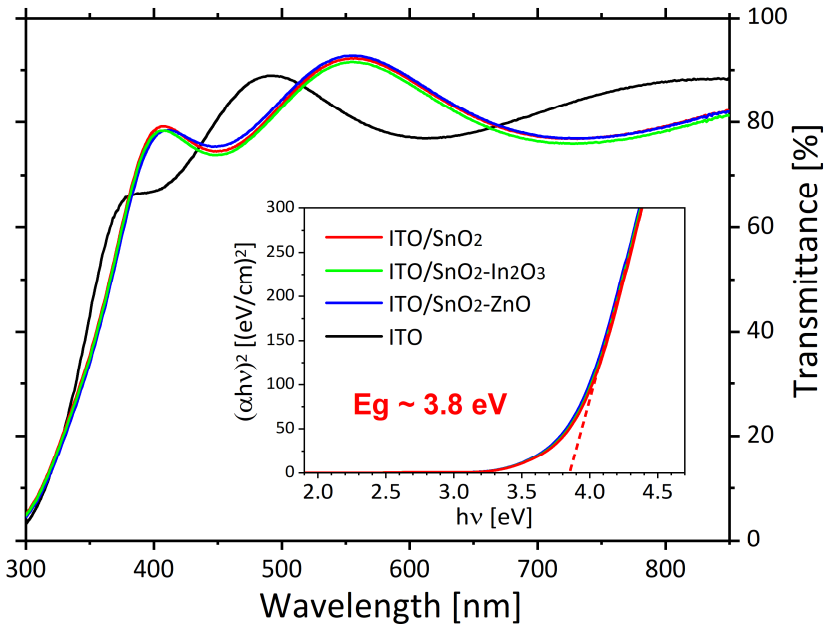

Figure S3. UV-vis transmission spectra of ETLs on ITO coated glass substrates and Tauc's plot (inset).

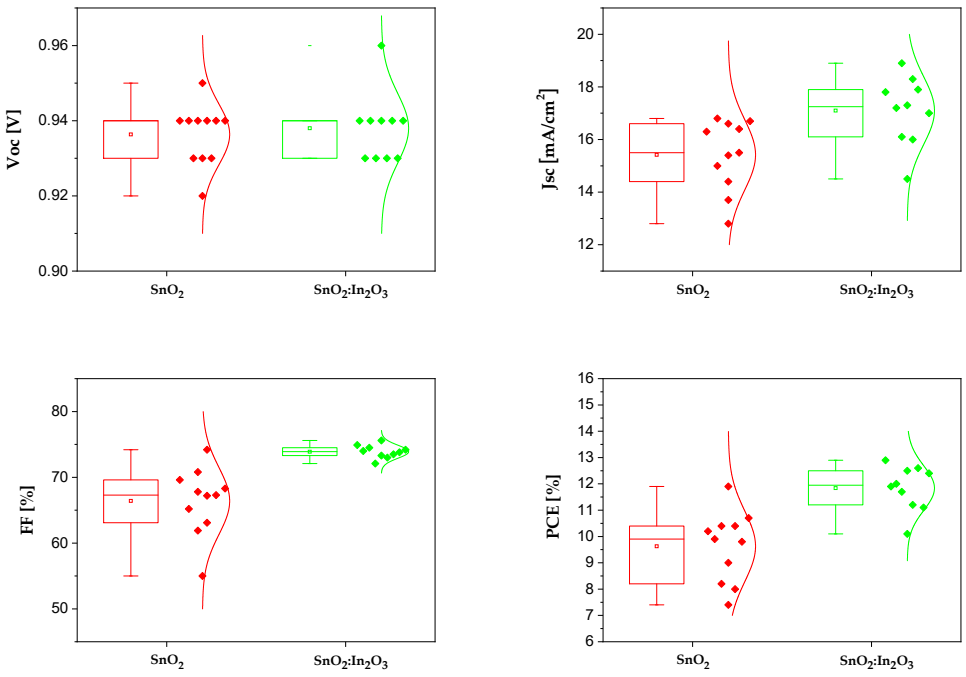

Figure S4. PV parameters of SnO_2 (in red) and SnO_2:In_2O_3 (in green) as different ETL for perovskite solar cells. Data are shown in Table S2.

Table S2. Average data and standard deviation extracted from J-V measurements of SnO_2 and SnO_2:In_2O_3-based PSCs.

ETL	n. samples	Jsc [mA/cm²]	Voc [V]	FF [%]	PCE [%]
SnO_2	11	15.4 ± 1.3	0.94 ± 0.01	66 ± 5	9.6 ± 1.3
SnO_2:In_2O_3	10	17.1 ± 1.3	0.94 ± 0.01	74 ± 1	11.8 ± 0.8

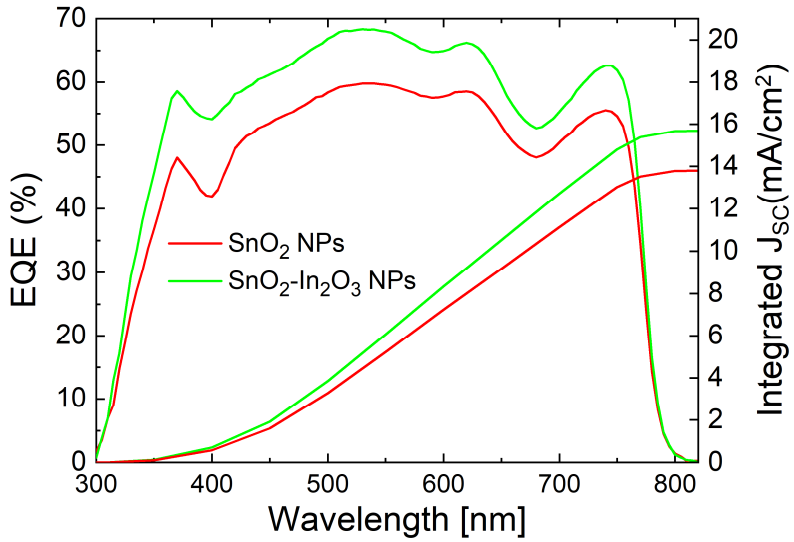

Figure S5. EQE spectra for SnO_2 (in red) and SnO_2:In_2O_3 (in green) based PSCs.