Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Effect of Density of Surface Defects on Photoluminescence Properties in $MAPbI_3$ Perovskite Films

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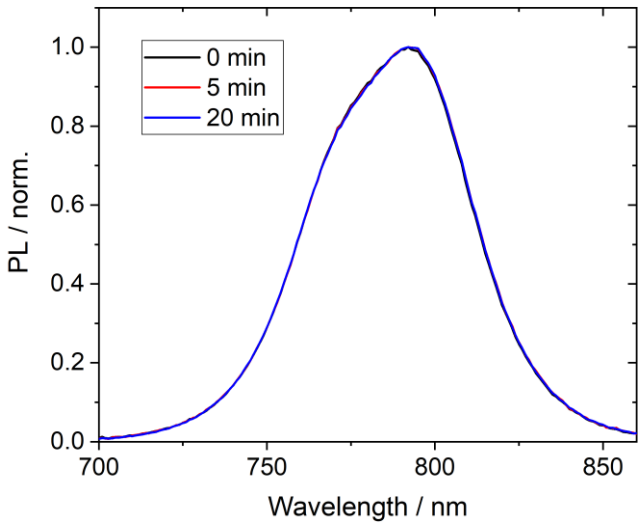

Figure S1: PL spectra of a glass/$MAPbI_3$ film with y = 3.03 after 0, 5 and 20 minutes of illumination with a 532 nm CW laser with an intensity of 120 mW/cm^2, measured inside an integrating sphere.

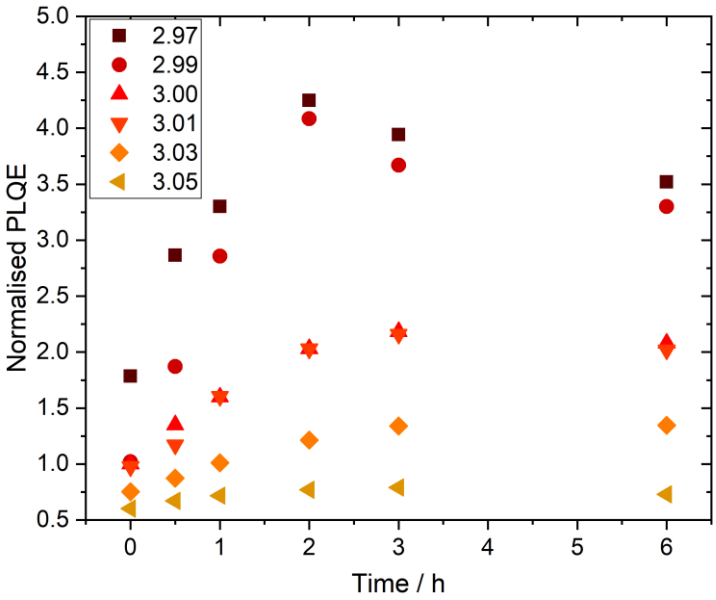

Figure S2: Temporal evolution of the PLQE upon long- term storage in ambient atmosphere and low levels of white light illumination for perovskite films fabricated from different stoichiometries y. The PLQE was normalized to the initial PLQE of the stoichiometric sample (y = 3.00) for ease of comparison to other batches.

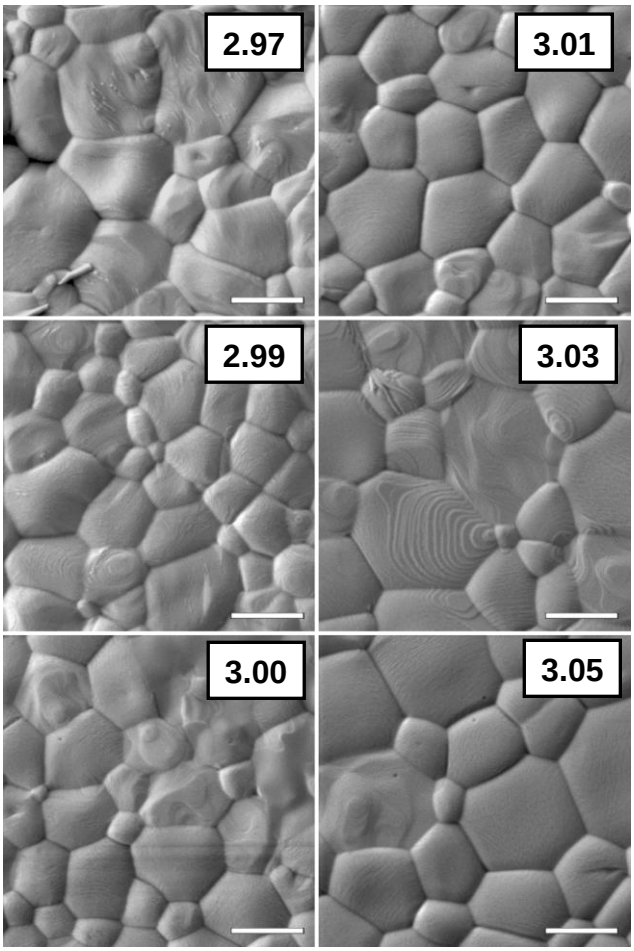

Figure S3: SEM images of perovskite films fabricated from different stoichiometries *y*. Scale bar is 1 μm.

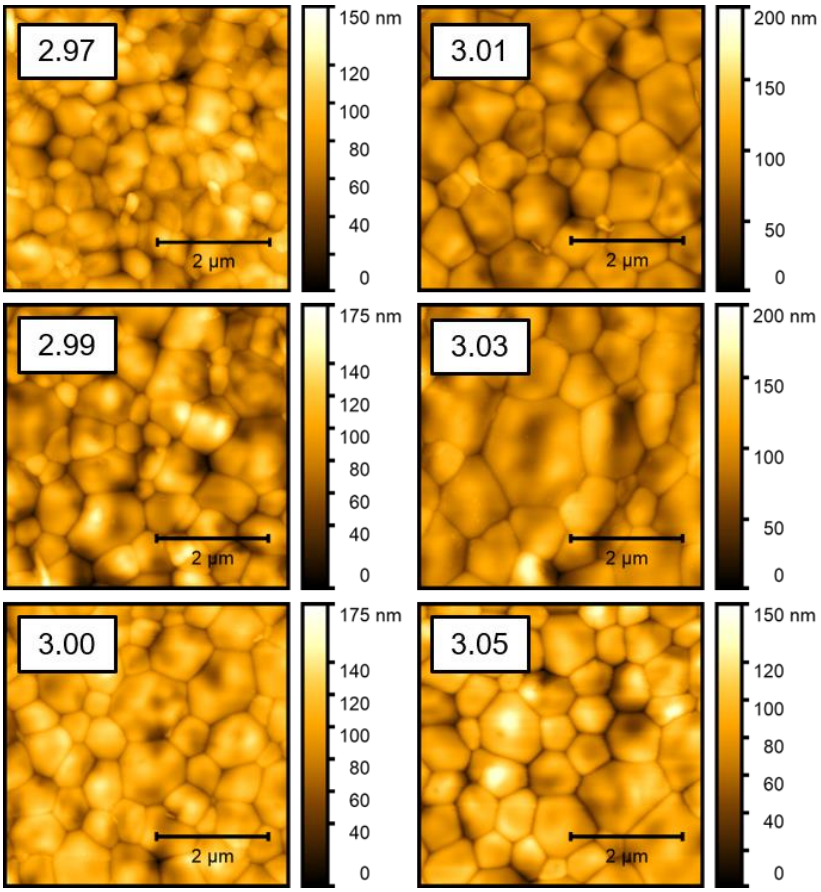

Figure S4: AFM micrographs of perovskite films fabricated from different stoichiometries *y*.

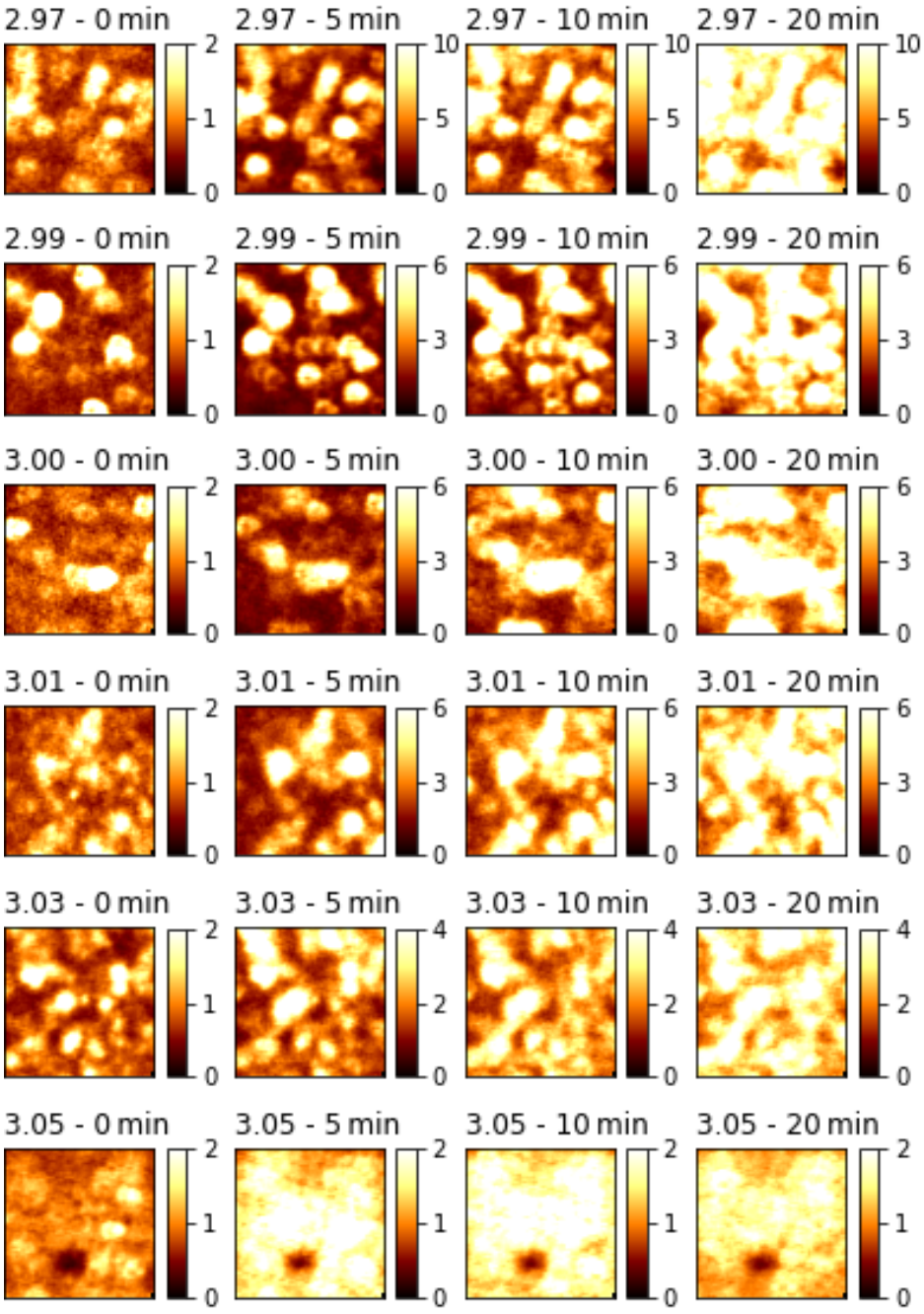

Figure S5: PL maps for all stoichiometries after 0, 5, 10 and 20 min of storage in ambient atmosphere and low levels of illumination, normalized to the average value of the 0 min map for each stoichiometry.

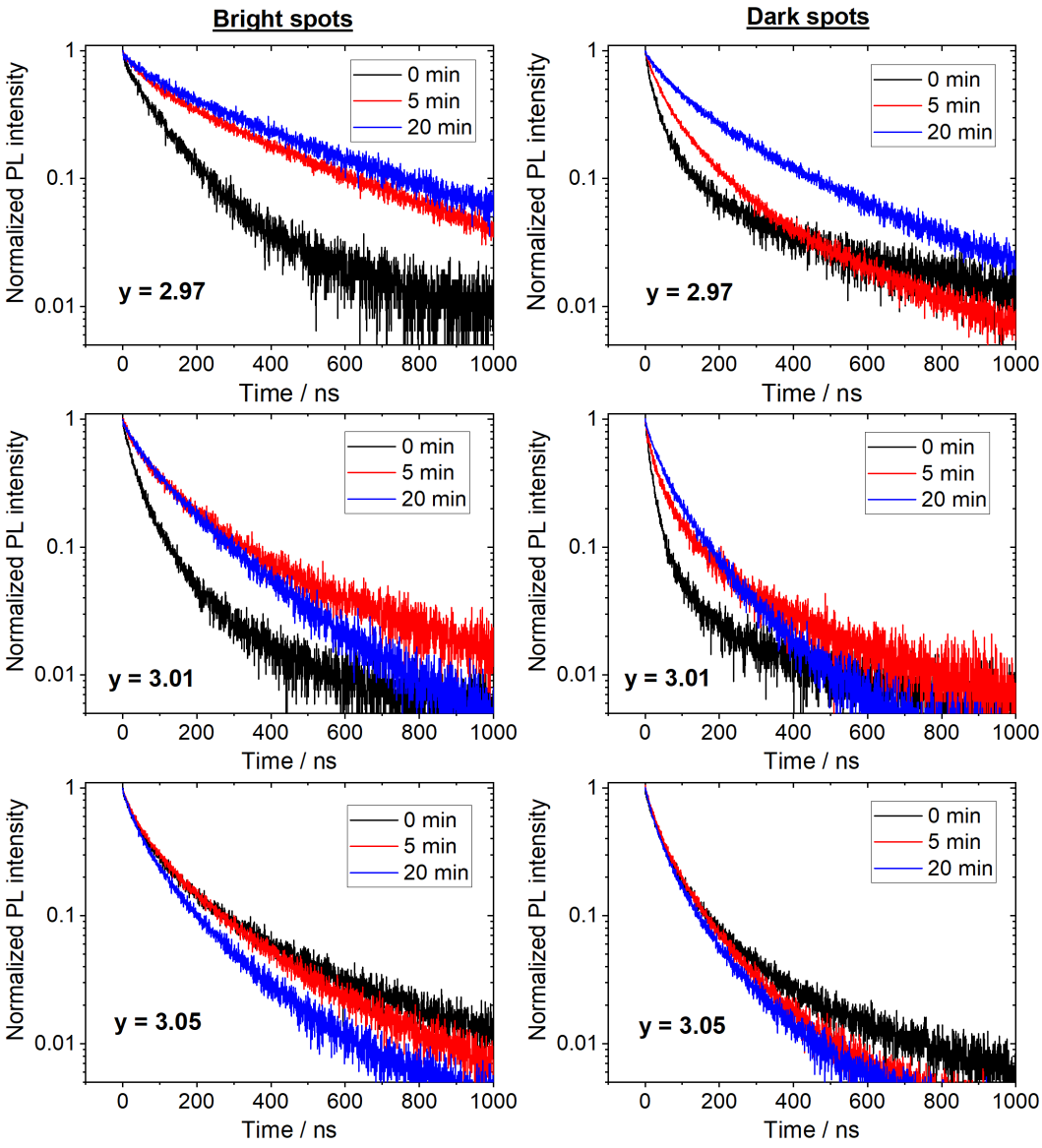

Figure S6: Representative PL decay data for stoichiometries y = 2.97/3.01/3.05 after 0, 5 and 20 minutes for bright (left) and dark (right) regions (see Figure 3 in the main text).

Table S1: Fit results using equation (2) for the **bright** PL regions (see Figure 4).

Fit parameters \ Stoichiometry *y*		**2.97**	**2.99**	**3.00**	**3.01**	**3.03**	**3.05**
0 min	A_1 (rel.)	0.02	0.08	0.10	0.44	0.12	0.30
	τ_1 [ns]	3	10	21	34	40	46
	A_2 (rel.)	0.98	0.92	0.90	0.56	0.88	0.70
	τ_2 [ns]	52	79	51	44	100	92
	b	0.73	0.58	0.44	0.61	0.65	0.63
	τ_{Av} [ns]	**89**	**114**	**122**	**52**	**125**	**106**
5 min	A_1 (rel.)	0.21	0.31	0.24	0.15	0.07	0.18
	τ_1 [ns]	45	27	50	74	27	49
	A_2 (rel.)	0.79	0.69	0.76	0.85	0.93	0.82
	τ_2 [ns]	247	209	100	91	207	89
	b	0.79	0.76	0.58	0.63	0.68	0.68
	τ_{Av} [ns]	**233**	**179**	**131**	**122**	**251**	**103**
10 min	A_1 (rel.)	0.12	0.25	0.1	0.18	0.07	0.22
	τ_1 [ns]	37	32	33	87	30	40
	A_2 (rel.)	0.88	0.75	0.9	0.82	0.93	0.78
	τ_2 [ns]	312	178	123	125	208	95
	b	0.79	0.73	0.63	0.69	0.72	0.74
	τ_{Av} [ns]	**312**	**171**	**161**	**147**	**241**	**97**
20 min	A_1 (rel.)	0.04	0.22	0.19	0.16	0.14	0.28
	τ_1 [ns]	2	35	38	51	58	41
	A_2 (rel.)	0.96	0.78	0.81	0.84	0.86	0.72
	τ_2 [ns]	245	174	186	116	196	77
	b	0.74	0.75	0.71	0.81	0.73	0.72
	τ_{Av} [ns]	**285**	**169**	**195**	**118**	**213**	**80**

Table S2: Fit results using equation (2) for the **medium** PL regions (see Figure 4).

Fit parameters \ Stoichiometry *y*		**2.97**	**2.99**	**3.00**	**3.01**	**3.03**	**3.05**
0 min	A_1 (rel.)	0.32	0.34	0.19	0.49	0.41	0.29
	τ_1 [ns]	43	34	36	26	39	48
	A_2 (rel.)	0.68	0.66	0.81	0.51	0.59	0.71
	τ_2 [ns]	45	35	25	23	68	73
	b	0.54	0.48	0.43	0.53	0.66	0.65
	τ_{Av} [ns]	**68**	**60**	**61**	**34**	**69**	**85**
5 min	A_1 (rel.)	0.23	0.25	0.17	0.24	0.10	0.25
	τ_1 [ns]	55	23	43	50	82	40
	A_2 (rel.)	0.77	0.75	0.83	0.76	0.90	0.75
	τ_2 [ns]	125	144	58	70	115	90
	b	0.65	0.74	0.57	0.57	0.63	0.75
	τ_{Av} [ns]	**145**	**135**	**86**	**96**	**155**	**90**
10 min	A_1 (rel.)	0.10	0.25	0.15	0.19	0.15	0.28
	τ_1 [ns]	48	29	47	40	86	39
	A_2 (rel.)	0.90	0.75	0.85	0.81	0.85	0.72
	τ_2 [ns]	161	160	81	101	129	89
	b	0.64	0.76	0.61	0.69	0.66	0.77
	τ_{Av} [ns]	**207**	**149**	**110**	**113**	**160**	**86**
20 min	A_1 (rel.)	0.15	0.27	0.18	0.15	0.12	0.33
	τ_1 [ns]	91	36	51	38	61	37
	A_2 (rel.)	0.85	0.73	0.82	0.85	0.88	0.67
	τ_2 [ns]	229	168	121	94	120	80
	b	0.75	0.77	0.68	0.78	0.67	0.77
	τ_{Av} [ns]	**247**	**154**	**139**	**98**	**146**	**75**

Table S3: Fit results using equation (2) for the **dark** PL regions (see Figure 4).

Fit parameters \ Stoichiometry *y*		**2.97**	**2.99**	**3.00**	**3.01**	**3.03**	**3.05**
0 min	A_1 (rel.)	0.45	0.30	0.24	0.66	0.55	0.40
	τ_1 [ns]	26	17	13	17	28	41
	A_2 (rel.)	0.55	0.70	0.76	0.34	0.45	0.60
	τ_2 [ns]	38	28	29	24	42	60
	b	0.47	0.42	0.43	0.48	0.55	0.62
	τ_{Av} [ns]	**57**	**62**	**63**	**27**	**45**	**69**
5 min	A_1 (rel.)	0.34	0.27	0.22	0.32	0.20	0.33
	τ_1 [ns]	46	29	28	26	55	33
	A_2 (rel.)	0.66	0.73	0.78	0.68	0.80	0.67
	τ_2 [ns]	80	44	37	41	63	65
	b	0.65	0.55	0.48	0.54	0.55	0.74
	τ_{Av} [ns]	**87**	**64**	**67**	**57**	**96**	**64**
10 min	A_1 (rel.)	0.14	0.22	0.18	0.31	0.14	0.35
	τ_1 [ns]	66	37	36	33	47	31
	A_2 (rel.)	0.86	0.78	0.82	0.69	0.86	0.65
	τ_2 [ns]	103	52	48	58	84	68
	b	0.61	0.58	0.54	0.62	0.62	0.76
	τ_{Av} [ns]	**139**	**72**	**74**	**67**	**111**	**62**
20 min	A_1 (rel.)	0.20	0.23	0.17	0.21	0.14	0.37
	τ_1 [ns]	73	45	30	37	55	32
	A_2 (rel.)	0.80	0.77	0.83	0.79	0.86	0.63
	τ_2 [ns]	165	76	70	62	77	59
	b	0.73	0.65	0.62	0.73	0.60	0.73
	τ_{Av} [ns]	**175**	**90**	**89**	**68**	**108**	**57**