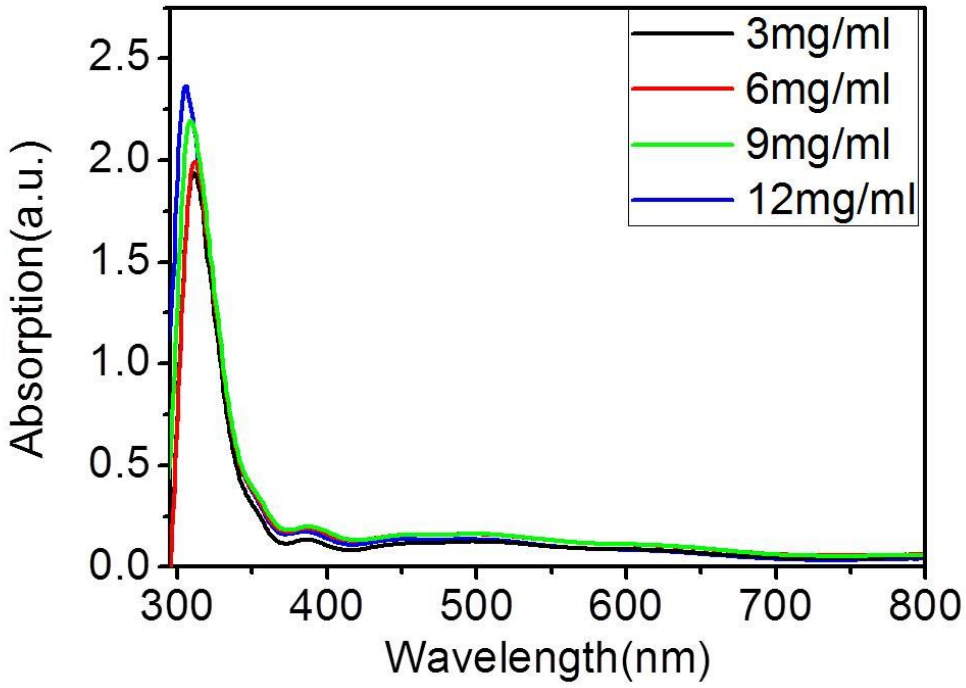

Fig. S1 UV-vis absorption spectra of TiO_2 via different concentration of MCA modification.

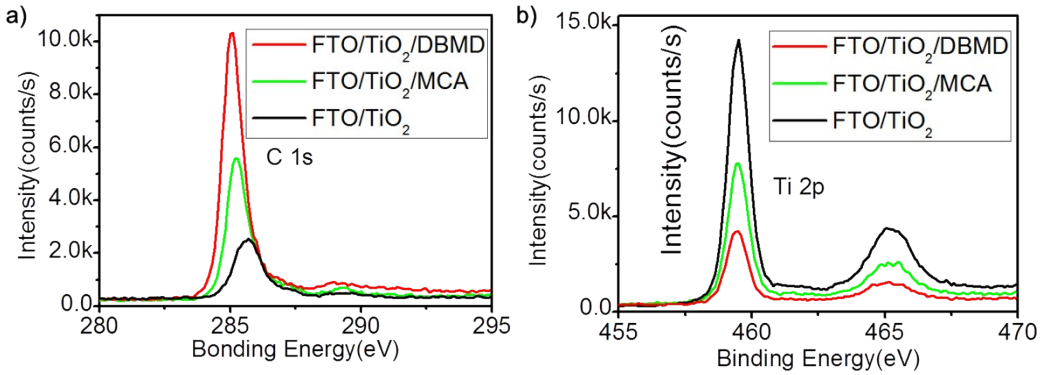

Fig. S2 Surface XPS analyses of a) carbon (285.0 eV (C1s)) and b) titanium (464.5 eV, $2p_{1/2}$, 458.8 eV, $2p_{3/2}$) from FTO/TiO_2 and FTO/TiO_2/MCA substrates.

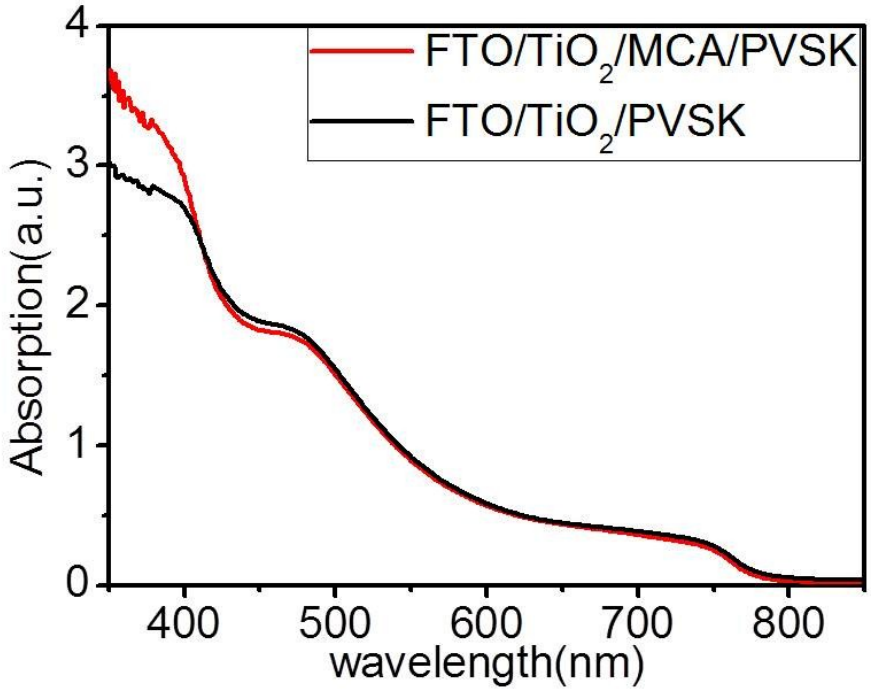

Fig. S3 Absorption spectra of perovskite film grown on TiO_2 and TiO_2/MCA.

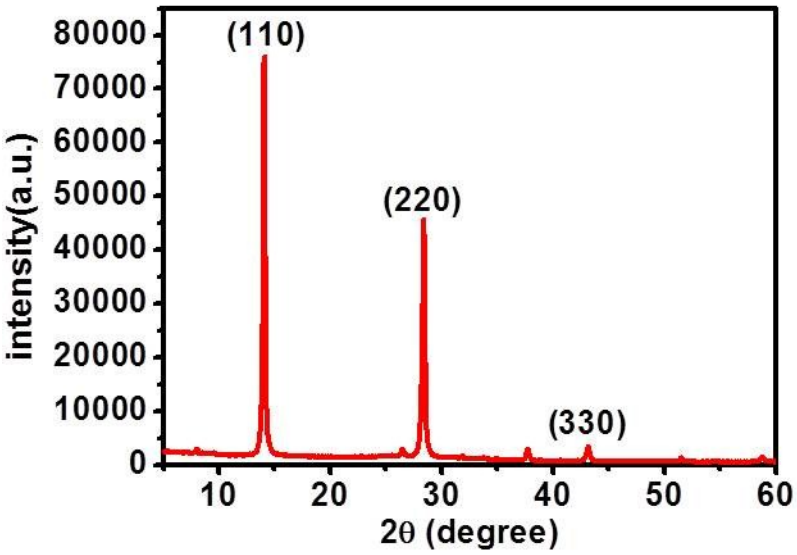

Fig. S4 XRD-pattern of the perovskite films grown on TiO_2 with MCA modification.

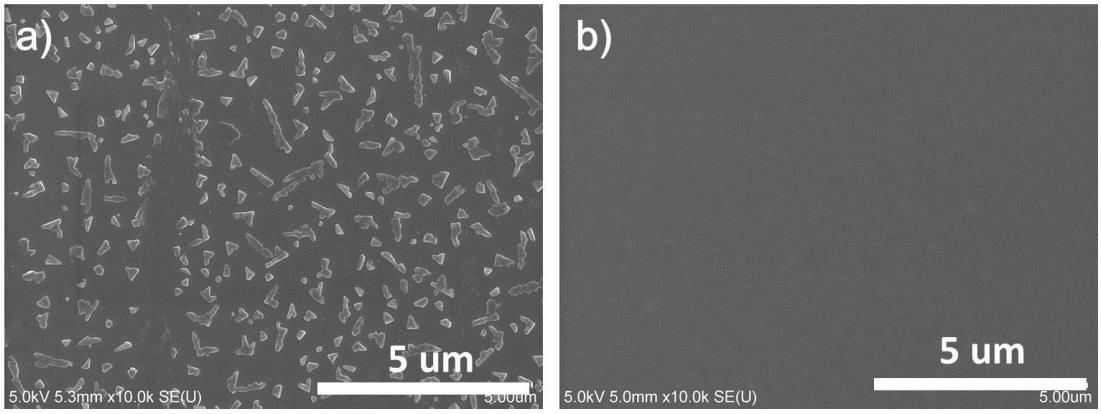

Fig. S5 SEM images of different substrate at the same scale a) FTO/ TiO_2, b) FTO/ TiO_2/MCA.

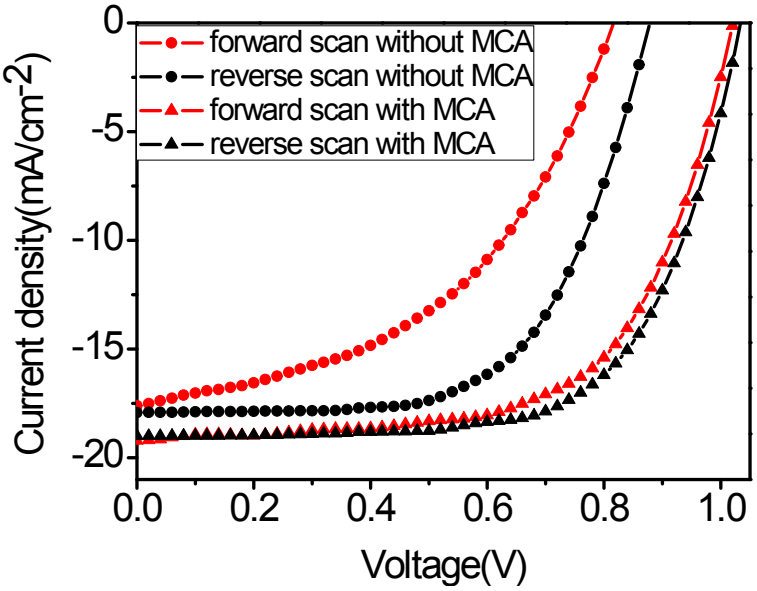

Fig. S6 *J-V* curves of larger active area cell from forward and reverse scan with and without MCA modification, with a delay time of 20 ms and a voltage step of 0.02 V s^{-1}.

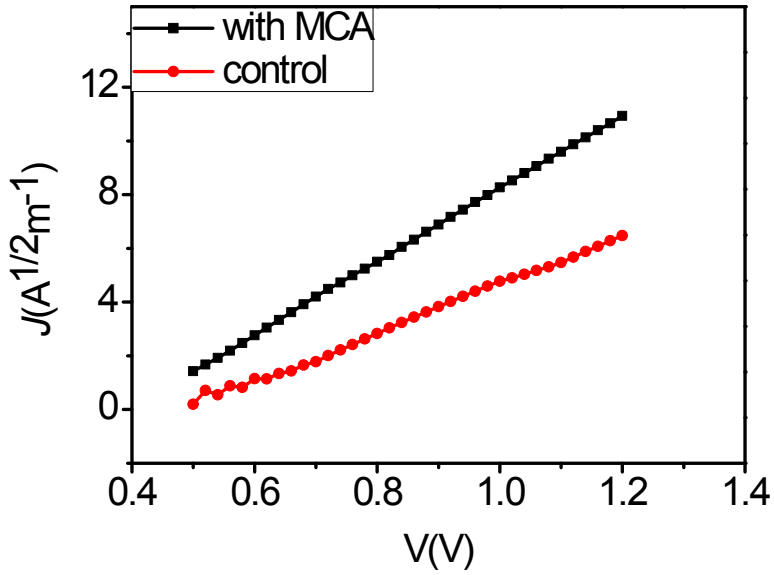

Fig. S7 *J-V* characteristics under dark for electron-only devices based on with and without MCA with the structure of FTO/ TiO_2/PVSK/PCBM/Ag.

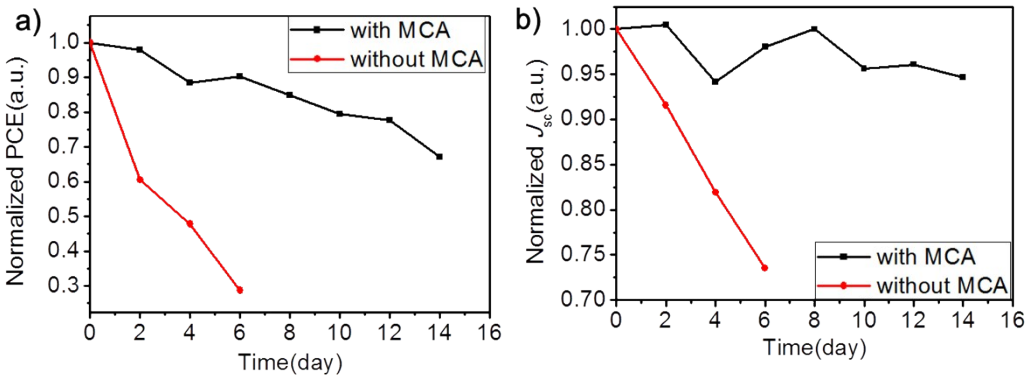

Fig. S8 Long-term stability tests of devices modified with MCA using forward scan mode.

Different concentrations of DBMB

Device	Voc(V)	Jsc(mA/cm2)	FF	PCE(%) Average
Control	0.987	12.5	26.59	3.29
	1.18	11.8	47.13	5.54
3mg/ml	0.988	19.3	43.81	8.35
	1.05	19.6	56.4	11.58
6mg/ml	1.09	19.7	64.60	13.85
	1.09	19.9	65.12	14.07
9mg/ml	1.16	18.3	66.66	14.14
	1.15	19.2	65.11	14.37
12mg/ml	1.07	18.9	59.78	12.16
	1.08	18.9	62.32	12.75

Table 1. Effect of MCA concentration on the performance of $CH_3NH_3PbI_3$ solar cells

Device	Voc(V)	Jsc(mA/cm2)	FF	PCE(%) Best
c-TiO_2 (FS)	0.81±0.01(0.82)	16.58±1.03(17.61)	49.21±2.43(46.78)	6.62±0.11(6.73)
c-TiO_2 (RS)	0.83±0.05(0.80)	18.06±0.22(17.84)	55.28±7.66(62.94)	8.30±1.56(9.86)
c-TiO_2/MCA(FS)	1.02±0.03(1.05)	19.20±0.25(19.45)	63.20±2.03(61.17)	12.39±0.1(12.49)
c-TiO_2/MCA(RS)	1.03±0.04(1.07)	18.96±0.45(19.41)	66.15±1.19(64.96)	12.97±0.47(13.44)

Table 2. The performance of the devices with larger active area.