Carrier Collection and Transport at *Interface* of Lead-Free Halide Perovskites (FA,MA)SnI_3 Solar Cells

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Charge extraction at carrier transport layers adjacent to perovskites is crucial for the optimization of perovskite solar cells. In particular, Sn–perovskites with no lead elements are known to struggle from charge extraction. Here, we report effects of organic ligands like FA and MA (FA = $HC(NH_2)_2^+$; MA = $CH_3NH_3^+$) on charge separation at the interface between electron transport layers and perovskites. TiO_2 mesoporous covering the tin-perovskites show significant changes in electronic structure and built-in potentials according to the ratio of FA to MA. Through a local probe with potential and current mapping, charge transport has been intensively examined. The best cell in this study is obtained as 5.37% at FA : MA = 3 : 1 with only iodine at the halide sites. Even though the value itself is not comparable with lead halides but it could pave a new direction to improve lead-free perovskite solar cells.

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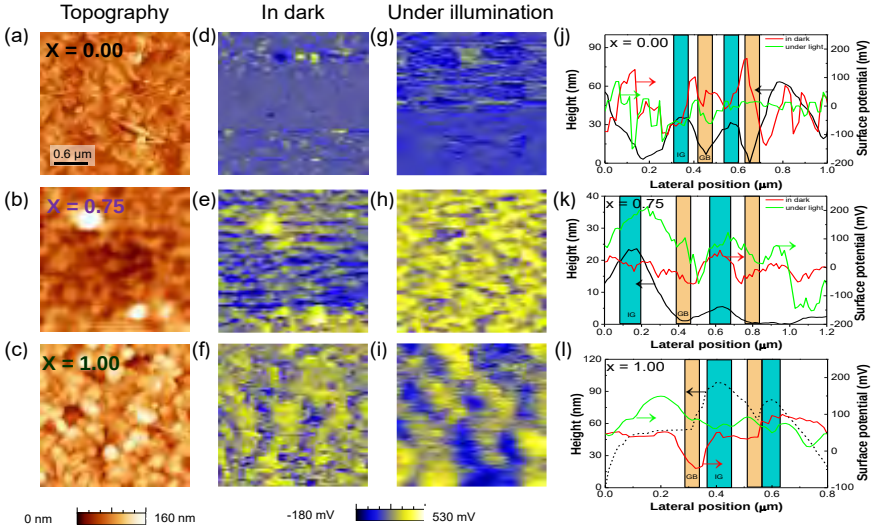

Figure 1. (a)–(c) Topography of the $FA_xMA_{1-x}SnI_3$/mesoporous TiO_2/blocking TiO_2/FTO substrate. (d)–(f) Surface potential of $FA_xMA_{1-x}SnI_3$ corresponding to the topography measured in the dark. (g)–(i) Surface potential of $FA_xMA_{1-x}SnI_3$ corresponding to the topography measured under illumination. (j)–(l) Surface potential profiles of $FA_xMA_{1-x}SnI_3$ corresponding to the topography measured in dark and under illumination.

Suplementary Pages (Optional)

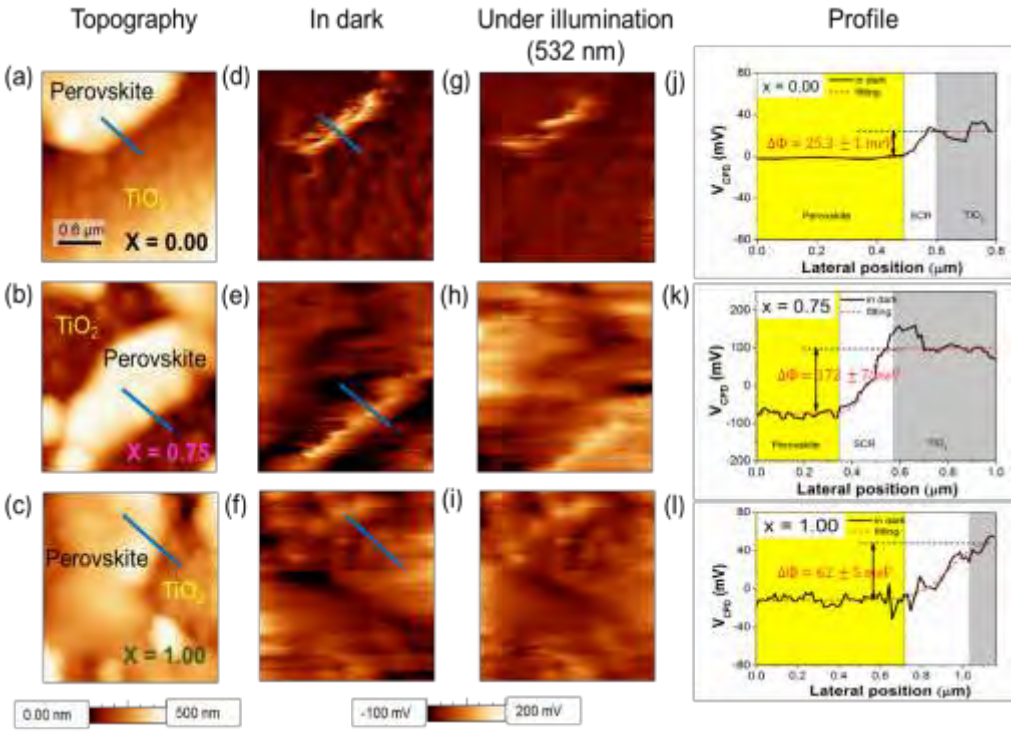

Figure S1. (a)–(c) Topography of the $FA_xMA_{1-x}SnI_3/TiO_2$ interfaces (x = 0.00, 0.75, and 1.00). (d)–(f) KPFM image corresponding to the topography in dark and (g)–(i) KPFM image corresponding to the topography under illumination (532 nm). (j)–(l) Potential profiles across the interface by a