Influence of anti-solvents on $CH_3NH_3PbI_3$ films morphology: Efficient and stable inverted planar perovskite solar cells

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Perovskite solar cells (PSCs) have intrigued a vast interest due to their low cost and easy fabrication processes. Among the different PSC structures, the inverted planar structure (*p*-i-*n*) has been identified as a promising candidate for commercialization due to their stable electrical behavior. *p*-i-*n* PSCs are constructed with a hole transport material, perovskite compound as the absorber (e.g-$CH_3NH_3PbI_3$) and an electron transport material. For efficient hole and electron transportation to the corresponding charge carrier layers, the morphology of the $CH_3NH_3PbI_3$ layer has remained detrimental. For crystallization of the $CH_3NH_3PbI_3$ various anti-solvents such as toluene, chlorobenzene (CB), xylene, ether etc.[1] have been extensively used for the fabrication of high efficient PSCs. However, the role of these anti-solvents concerning the stability of *p*-i-*n* PSCs has not been evaluated till now. In this study, we present the stability dependence of four anti-solvents in high efficiency *p*-i-*n* PSCs (Figure 1). Our analysis onto the post fabrication of *p*-i-*n* PSCs highlight that, anti-solvent treatment by toluene and chlorobenzene results in most stable device performance measured under 1 sun for 30 days. Successful formation of large grains with grain boundaries only along the vertical direction of the cross section are formed by toluene and chlorobenzene dripping which is beneficial for passivation of $CH_3NH_3PbI_3$ by Phenyl-C61-butyric acid methyl ester ($PC_{61}BM$) [2].

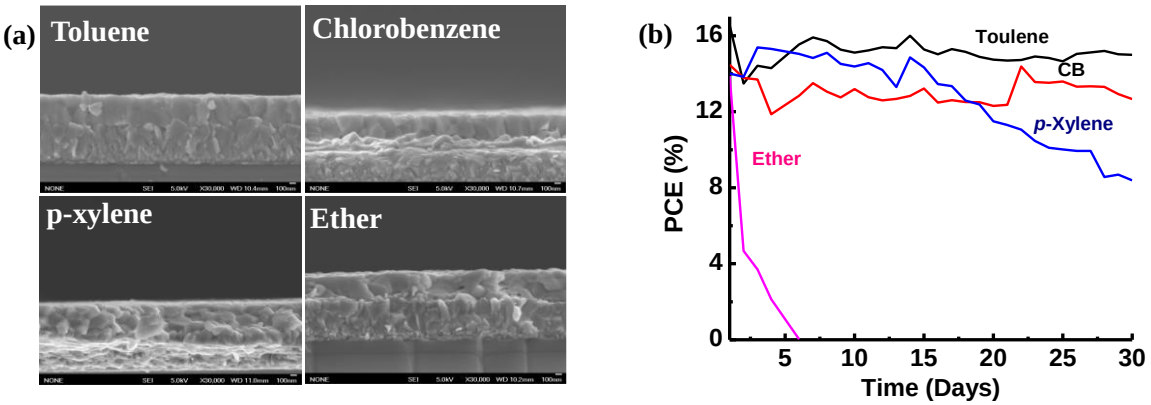

Figure 1 (a) Scanning electron micrographs of $CH_3NH_3PbI_3$ cross sections dripped with four types of anti-solvents; (b) stability comparison of power conversion efficiencies of inverted planar PSCs.

References
[1] Paek, S., et al.; *Chemistry of Materials* 29 (2017) 3490-3498.
[2] Shao, Y., et al.; *Nature communications* 5 (2014) 5784.