Fabrication of Perovskite Solar Cells via Nozzle-Jet Printing Technique

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The rapid rise in the efficiency of perovskite solar cells (PSCs) using a mixed-halide organolead compound has received much attention in recent years for high energy conversion. In this study, we present a novel printing technique, named nozzle-jet printing (NJP), which is capable of achieving a compact TiO2 (C-TiO2), mesoporous TiO2 (MP-TiO2) and CH3NH3PbI3 (MAPbI3) layer under ambient conditions. With the combined optimization of printing parameters and ink compositions, C-TiO2, MP-TiO2 and MAPbI3 patterns with favorable morphology and high uniformity are realized. Besides, we found that the temperature of the substrate plays an important role to achieve uniform morphology and high crystallinity of MAPbI3 patterns during the printing process. Compared to the conventional method spin-coating, when such printed patterns (C-TiO2/MP-TiO2/MAPbI3) are embedded in PSCs, we obtain a better performance of power conversion efficiency (PCE), open-circuit voltage (Voc), short-circuit photocurrent density (Jsc) and fill factor (FF) of up to 5.89%, 0.72 V, 15.11 A and 54.10% in air condition with a humidity of 40%. These results indicate that the NJP technique has the potential to complete each layer in different types of solar cells.