Short Communication

Preparation of High-Crystallinity and Large-Grain Br-doped Methylammonium Lead Iodide Thin Films at the Temperature Range of 100~140°C

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Br-doped methylammonium lead iodide (CH$_3$NH$_3$PbI$_{3-x}$Br$_x$) thin films with high crystallinity and large grain sizes were successfully obtained by converting a PbI$_2$·N-methyl-2-pyrrolidone (NMP) complex thin film using a conversion temperature and conversion time of 140 °C and 10 min, respectively. The influence of the conversion temperature on the crystal phase, morphology, optical absorption and chemical composition of the CH$_3$NH$_3$PbI$_{3-x}$Br$_x$ thin films was systematically investigated, and the photovoltaic performance of the corresponding planar perovskite solar cells was evaluated. The crystallinity of the CH$_3$NH$_3$PbI$_{3-x}$Br$_x$ thin films was enhanced, and their grain size gradually increased, with an increase in the conversion temperature from 100 °C to 120 °C to 140 °C. The planar perovskite solar cells based on films converted at 140 °C showed the best photoelectric conversion efficiency (PCE) of 13.56 %, with an open-circuit voltage ($V_{oc}$) of 1.01 V, a short-circuit photocurrent density ($J_{sc}$) of 18.90 mA·cm$^{-2}$, a fill factor (FF) of 0.71, and an average PCE of 12.46±1.10 %, with $V_{oc}$ of 0.99 ± 0.03 V, $J_{sc}$ of 18.31±1.16 mA·cm$^{-2}$ and FF of 0.69 ± 0.04, all measured at a relative humidity of 50-54 % under illumination by simulated AM 1.5 sunlight (100 mA·cm$^{-2}$).

Keywords: Conversion temperature; Conversion time; PbI$_2$·NMP; CH$_3$NH$_3$PbI$_{3-x}$Br$_x$; Planar perovskite solar cell

FULL TEXT

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