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## Nickel Oxide Thin Films Prepared by Using Nickel Nitrate/Acetate for Hole Transporting Layer in Perovskite Solar Cells

Nickel oxide (NiOx) thin films prepared by using nickel acetate and nitrate as hole transporting layer (HTL) in perovskite solar cells (PSCs) were studied. Herein, the effect of concentrations of nickel acetate (0.1, 0.2, and 0.3 M) mixed with a fixed 0.1 M of nickel nitrate for NiOx thin film preparation was investigated. The crystal structure and optical properties were characterized by X-ray diffractometry (XRD) and ultraviolet-visible spectroscopy (UV-vis). The inverted perovskite solar cell architecture of FTO/NiOx/Perovskite/PC60BM/Ag was carried out and investigated for solar cell characteristics. It is found that the PSC devices fabricated by using nickel nitrate 0.1M mixed with nickel acetate 0.2 M exhibited a maximum power conversion efficiency (PCE) of 14.5 % (compared to 11.0 % of the device fabricated with using only nickel acetate). The PCE enhancement can be elucidated by the significant improvement of the interface between NiOx and perovskite layer as observed in an increase of photocurrent, fill factor, and a decrease of hysteresis. These results suggest that the NiOx thin films prepared by the appropriate mixing of nickel nitrate and acetate can be applied as HTL and can enhance the PCE of perovskite solar cells.

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