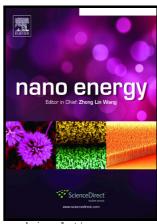
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Breakthroughs in NiO_x-HTMs towards stable, low-cost and efficient perovskite solar cells Sajid Sajid¹, Ahmed Mourtada Elseman^{1,2}, Hao Huang¹, Jun Ji¹, Shangyi Dou¹, Haoran Jiang¹, Xin Liu¹, Dong Wei¹, Peng Cui¹, Meicheng Li^{1*}

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Abstract

Although revolutionary progress in power conversion efficiencies (PCEs) of perovskite solar cells (PSCs) greater than 22 % has accompanied significant advances in materials engineering, processing, and device architectures, the selection of proper hole transporting materials (HTMs) is still critical for high efficiency, low-cost and long-term stability. The PSCs community is actively investigating a group of HTMs for high efficiency and long-term stability with commercial viability. In this context, inorganic nickel oxide (NiO_x)-HTMs possess the advantages of energetically favorable energy band positions, high hole mobility, superior chemical stability, and low cost manufacturing. Herein, we address the initial breakthroughs and recent progress in NiO_x-HTMs for PSCs. In addition to synthetic routes and deposition techniques used for NiO_x-HTMs in two major device architectures (p-i-n and n-i-p structure), the stability and cost-breakdown of PSCs are evaluated in details. Finally, future directions for further improvements on issues such as high efficiency, stability and low-cost of PSCs based on NiO_x-HTMs are also provided.

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