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Review

Advances in hole transport materials engineering for stable and efficient perovskite solar cells

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ABSTRACT

This article reviews the various hole transporting materials (HTMs) used in perovskite solar cells (PSCs) in achieving high photo-conversion efficiency (PCE) and operational stability. The PSCs are the latest development in solution processable solar cells offering PCE (~22%) on a par with that of practically deployed silicon and thin film solar cells. HTMs and electron transporting materials (ETMs) are important constituents in PSCs as they selectively transport charges within the device, influence photovoltaic parameters, determine device stability and also influence its cost. This article critically approaches role of structure, electrochemistry, and physical properties of varied of choice of HTMs categorized diversely as small and long polymers, organometallic, and inorganic on the photovoltaic parameters of PSCs conceived in various device configurations. Achievements in tailoring the properties of HTMs to best fit for PSCs are detailed; a well-designed HTM suppresses carrier recombination by facilitating the passage of holes but blocking electrons at the HTM/perovskite interface. Moreover, in many PSCs the HTM acts as the first line of defense to external degrading factors such as humidity, oxygen and photon dose, the extent of which depends on its hydrophobicity, permeability, and density.