Monolayers with Different Anchoring Groups for Perovskite Solar Cells

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Abstract

Inverted perovskite solar cells (iPSCs) are increasingly using self-assembled monolayers (SAMs) as hole-transporting materials due to their ease of formation and cost-effectiveness. A well-known example of SAMs is phosphonic acid with a carbazole moiety and various functional groups. Despite promising results, the relationship between the molecular structure of SAMs and the electrical properties of iPSCs remains unclear. While it is well established in the literature that certain anchoring groups, like phosphonic acid, have the capability to form a monolayer with strong bonds on the surface of oxides, there is limited knowledge regarding how the anchoring group impacts the properties of the monolayers (including surface coverage, wetting angle, work function fine-tuning). However, there was a manuscript with triphenylamine-based boronic acids, where the manuscript authors claimed that boronic acids are the more suitable choice due to less acidity and potentially increased stability. Despite that, boronic acid is known to be less stable and has a weaker bond with the surface than phosphonic acid. This study aims to determine whether triphenylamine-based phosphonic acid monolayers with different functional groups are a better alternative to boronic acids for creating efficient and stable solar cells. We synthesized a series of molecules with phosphonic anchoring groups as hole-transporting materials in iPSC devices. Further research is underway to test molecules with phosphonic and boronic anchoring groups and analyze their differences to better understand how they relate to photovoltaic device performance.

Keywords

Hole Transporting Material, Self-Assembled Monolayer, Perovskite Solar Cells