Flexible ITO-free organic solar cells

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Abstract

Thin film solar cells based on organic semiconducting materials will play a role in the next generation renewable energy mix due to their mechanical flexibility and the potential for low-embedded energy large-scale roll-to-roll manufacturability. Steady and sustained progress has now led to high power conversion efficiencies (PCE) of over 15 % for single junction and 17% for multiple junction solar cells.

Current state-of-the-art thin films solar cells typically use indium tin oxide (ITO) as the transparent conducting electrode (TCE). However, ITO has some intrinsic weaknesses that limit its viability as the TCE for next-generation optoelectronic devices, including high cost, limited supply of indium, and its brittleness, which can lead to fracturing when devices are flexed. In this presentation we report the development bendable solar cells that are ITO free in which the substrate is either flexible glass or plastic and the TCE is either multilayer poly(3,4-ethylenedioxythiophene):poly(styrene sulfonate) (PEDOT:PSS) or graphene. We report how the number of layers governs the trade-off between transmittance and sheet resistance of the TCE and how the performance of the devices is dependent on the materials and device combinations. We also compare the performance of the devices with those made using commercial ITO on non-flexible glass substrates.