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Toward indium-free optoelectronic devices: Dielectric/metal/dielectric alternative transparent conductive electrode in organic photovoltaic cells

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Mots-clés	dielectric materials [4], metal electrodes [5], Organic solar cells [6], transparent conductive oxides [7]
Résumé en anglais	Depending on their resistivity and their transmittance, the thin films of transparent conductive oxide (TCO) are widely used in optoelectronic devices. In_2O_3:Sn (ITO) is the most widely used TCO in optoelectronic devices. As indium is scarce and ITO is limited in flexibility due to its ceramic structure, many studies have been dedicated to new transparent conductive electrodes. This review article presents the state-of-the-art concerning the dielectric/metal/dielectric structures and their application as transparent electrodes in organic photovoltaic cells (OPVCs). First, TCO/Ag/TCO structures were created to achieve higher conductivity than ITO films. Then others dielectrics have been used such as transition-metal oxides (WO_3, MoO_3, V_2O_5, etc.), ZnS, etc. Such structures exhibit excellent flexibility, high conductivity, and good transparency. They can be deposited onto substrates at room temperature by simple evaporation under vacuum. Moreover, it is possible to manage the anode work function through the choice of the dielectric, which can allow them to be used as cathodes or anodes and as intermediate electrodes in tandem solar cells. The properties of the dielectric/metal/dielectric (D/M/D) structures depend on the thickness of the different layers. The threshold thickness value of the metal film is usually around 10 nm, where the structures change from an insulating state to a highly conductive state. This is attributed to the percolation of conducting metal paths. The transmittance of the films increases when the metal thickness increases up to the percolation thickness, while further increase induces a decrease in transmittance. Finally, the nature and the thickness of the dielectric layers can be chosen as a function of the device properties requested, which is illustrated through different examples of OPVCs.
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