

A Low-Cost Dye Solar Cells Based on Ordinary Glass as Substrates

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Abstract : The back contact dye solar cells (BCDSCs), in which the transparent conductive oxide (TCO) is omitted, have the potential to use intact low-cost general substrates such as glass, metal foil, and papers. Herein, we introduce a facile manufacturing method of a Ti back contact electrode for the BCDSCs. We found that the polylinkers such as poly(butyl titanate) have a strong binding property to make Ti particles connect with one another. A porous Ti film, which consists of Ti particles of $\leq 10\text{ nm}$ size connected by a small amount of polylinkers, has an excellent low sheet resistance of 10 ohm sq^{-1} for an efficient electron collection for DSCs. This Ti back contact electrode can be prepared by using a facile printing method under normal ambient conditions. Conjugating the new back contact electrode technology with the traditional monolithic structure using the carbon counter electrode, we fabricated all TCO-less DSCs. These four-layer structured DSCs consist of a dye-adsorbed nanocrystalline TiO_2 film on a glass substrate, a porous Ti back contact layer, a ZrO_2 spacer layer, and a carbon counter electrode in a layered structure. Under AM 1.5G and 100 mWcm^{-2} simulated sunlight illumination, the four-layer structured DSCs with N719 dyes and I^-/I_3^- redox electrolytes achieved PCEs up to 5.21%.

Keywords : dye solar cells, TCO-less, back contact, printing, porous Ti film

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