Optically Transparent FTO-Free Cathode for Dye-Sensitized Solar Cells

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A traditional counterelectrode in dye-sensitized solar cell (DSC) is platinized F-doped SnO_2 (FTO). However, the cost of FTO glass is estimated to be about >20-60% of the cost of the DSC-module, which is a strong motivation for FTO replacement by cheaper materials. Recently, nanocarbon and graphene-based materials attracted considerable attention, particularly for Co-mediated DSCs. Another alternative, which also works well with the I_3^-/I^- redox mediator, is the woven fabric consisting of transparent PEN fibers in warp and electrochemically platinized tungsten wires in weft. This electrode outperforms the thermally platinized FTO in serial ohmic resistance, R_s (1.5 vs. 8.2 Ωcm^2), charge-transfer resistance for triiodide reduction (0.59 Ωcm^2 vs. 0.76 Ωcm^2) and offers comparable or better optical transparency in the visible and particularly in the near-IR spectral region (≈80%). The Pt-W/PEN cathode exhibits good stability during electrochemical load with the maximum (diffusion-limited) current both in cathodic and anodic directions, and during long term (≈month) storage at open circuit. The practical dye-sensitized solar cells with either Pt-W/PEN or Pt-FTO cathodes show similar performance, confirming that the former is a promising alternative for replacement of conductive glass in the DSC counterelectrodes.

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