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ZnO-based Dye-Sensitized Solar cells: Effects of Redox Couple and Dye Aggregation

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Abstract

The performance of ZnO-based dye sensitized solar cells (DSSCs) has always been lower than TiO_2-based devices, however, the factors for this difference are still not entirely understood. Here we use current - voltage curves in combination with intensity-modulated photovoltage spectroscopy, charge extraction measurements, and surface photovoltage spectroscopy to gain insight in the photochemical charge separation in ZnO-based DSSCs. Devices were fabricated with electrodeposited nanostructured, mesoporous ZnO films, an organic fluorenyl-thiophene dye (OD-8) as sensitizer, and an electrolyte solution with either the I^-/I_3^- or $[Co(2,2'\text{-bipyridyl})_3]^{2+/3+}$ redox couple. Surface photovoltage measurements and scanning electron microscopy images show that Zn^{2+}-dye aggregates are most likely the cause of a decrease in cell performance with sensitization times longer than 4 hours, due to the relatively acidic acrylonitrile bonding moiety of the OD-8 dye. Charge extraction measurements combined with intensity-