Carotenoic acid sensitizers for dye-sensitized solar cells

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Abstract:

The paradigm change in electrical power generation demands for new and cheap renewable energy sources. The dye-sensitized solar cell is a promising candidate which is currently under intense investigation. It consists of a dye-sensitized mesoporous titania film which serves as light absorber and an electrolyte for the dye regeneration, both are sandwiched between two FTO coated glasses. We evaluated the carotenoic acid sensitizers bixin, crocetin and torularhodin using an improved fabrication, which protects the sensitizer against the photo catalytic degradation during cell fabrication. This allowed us to increase the conversion efficiency of our cells to up to 1.8% under AM 1.5 illumination. To our knowledge these are the highest values reported so far for these sensitizers. Furthermore we used quantum efficiency measurements to investigate the injection efficiencies and electron diffusion lengths. Open circuit voltage decays and charge extraction measurements were made for the determination of effective electron lifetimes in the sensitized titania films. The results suggest that the dye coverage for the natural sensitizers is not yet optimized, which causes relatively high recombination rates compared to standard dyes like N719.

Anyhow, we believe that the conversion efficiencies can be further improved by addressing the mentioned issues by an optimization of the electrolyte as well as a modification of the sensitizers.