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Conversion of sunlight to electric power by nanocrystalline dye-sensitized solar cells $\hat{\sim} \dagger$

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Abstract

The dye-sensitized solar cell (DSC) provides a technically and economically credible alternative concept to present day p-n junction photovoltaic devices. In contrast to the conventional silicon systems, where the semiconductor assumes both the task of light absorption and charge carrier transport the two functions are separated here. Light is absorbed by a sensitizer, which is anchored to the surface of a wide band gap oxide semiconductor. Charge separation takes place at the interface via photo-induced electron injection from the dye into the conduction band of the solid. Carriers are transported in the conduction band of the semiconductor to the charge collector. The use of sensitizers having a broad absorption band in conjunction with oxide films of nanocrystalline morphology permits to harvest a large fraction of sunlight. Nearly quantitative conversion of incident photon into electric current is achieved over a large spectral range extending from the UV to the near IR region. Overall solar (standard AM

1.5) to current conversion efficiencies of 10.6% have been reached. New electrolytes based on ionic liquids have been developed that show excellent stability both under prolonged light soaking and high temperature stress. There are good prospects to produce these cells at lower cost than conventional devices. Here we present the current state of the field, and discuss the importance of mastering the interface of the mesoporous films by assisting the self-assembly of the sensitizer at the surface of the oxide nanocrystals.



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Keywords

Dye-sensitized solar cell; Nanocrystalline; Sensitizer

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† Dedicated to Prof. Shozo Yanagida on the occasion of his retirement.

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