Stable performance of DSSCs under ''pan-illumination'' lighting conditions through optimized electrolyte formulation

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Abstract:

A finely tuned I^-/I_3^- redox electrolyte formulation allows for DSSCs with good performance that is maintained during radical changes in lighting conditions. The formulation parameters including iodide source, solvent mixture and additives have been consciously selected and modified to achieve component synergy leading to highly performing electrolyte solution despite the low iodine concentration. The electrolyte was characterized optically and voltammetrically, before being integrated into DSSCs that were evaluated under a variety of illumination conditions. In comparison with a benchmark indoor optimized electrolyte, the novel formulation led to DSSCs with excellent efficiencies under indoor light, while significantly outperforming the reference cells under 1 sun. Detailed electrochemical characterization of the novel cells, through Action Spectra, Electrochemical Impedance and Ionic Diffusion analyses as well as linearity tests of cell performance as a function of the incident power highlight the results of the tailored electrolyte optimization. Through the conscious tuning of the electrolyte’s optical characteristics, mass transport properties and component synergy, the novel DSSCs are able to adapt to significantly different lighting types and illumination intensities, without the usual loss of efficiency, maintaining good performance while operating under a wide range of lighting conditions: from ~0.03 mW/cm^2 of indoor illumination (100 lux) to 100 mW/cm^2 of solar simulated light (1 full sun).