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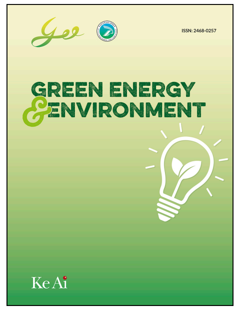

Amazing Long-Lived Lifetime

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Highlight

Amazing Long-Lived Lifetime

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Bulk thanks to their characteristics of being environmentally benign, easily fabricated and relatively stable, dye-sensitized solar cells (DSSCs) have attracted attention over decades as a potential alternative to solar energy conversion.[1] However, as L. M. Peter pointed out in 2011, "although much more is now known about the physical and chemical processes taking place during operation of the DSSCs, the exponential increase in research effort during this period has not been matched by large increases in efficiency".[2] To date, the highest photoelectronic conversion efficiency (PCE) for DSSCs is 14.3% achieved by Hanaya and co-workers,[3] which falls far behind the new game player, the current record-holding perovskite.[4] Due to their as yet unfulfilled promise, the innovative and focused research is urgently needed to address the fundamental limitations holding back the progress of PCE in DSSCs.

Surface-bound chromophores are essential to DSSC architectures. The two most influential parameters of DSSCs such as photocurrent and photovoltage are closely dependent upon a material's light-harvesting, electron-injection, dye-regeneration and charge-collection efficiency. Considerable efforts have been devoted to optimize cell performances; these include modifying the traditional D-π-A structured sensitizers to a D-A-π-A motif which better tunes the energy levels,[5,6] replacing the iodine redox couple with cobalt electrolyte for higher photovoltage,[7] and cosensitizing with two or more dyes as "dye cocktails" to gain better spectral response.[8,9] As the key process in DSSCs, how to well controll the kinetics of electron injection is closely correlated with favorable photocurrent and photovoltage, and has been identified as a promising method to improve PCE.[10,11] In conventional DSSCs, a significantly long lifetime of oxidized sensitizer is required for efficient electron-injection and dye regeneration from the redox mediator. Given that the electron/hole injection is commonly followed by fast charge recombination, longer redox-separated (RS) state lifetime represents an important goal as it provides additional time to extract the absorbed photon energy. Recently, Meyer and co-workers have achieved an unprecedented breakthrough in the realm of RS lifetimes.[12] Using a simple toolkit of molecular components to create dye-sensitized solar energy applications, the authors realized remarkable RS lifetimes on the order of milliseconds to seconds, playing a microscoptic role of molecular analogures in semiconductor p/n junctions.