Structural planarity and conjugation effects of multi-carbazole derivatives organic dyes for dye-sensitized solar cells

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Dye-sensitized solar cells (DSSCs) based on Ru-complexes have been achieved fairly high solar energy-to-conversion efficiencies above 12 %. However, the Ru-complexes have some problems such as manufacturing costs and environmental issues. Recently, organic dye molecules have been employed as promising alternatives to the Ru-complexes because of potential advantages (high molar extinction coefficient, convenient, customized molecular design) for photophysical and photochemical properties, as well as low-cost production. In this work, we demonstrate the synthesis of organic photosensitizing dyes with varying carbazole-based chromophores in a molecule, and used as sensitizers for dye-sensitized solar cells (DSSCs). We found that organic dye with thiophene units exhibited a higher molar extinction coefficient and red-shifted absorption, which leads to an improved light harvesting efficiency. Their photovoltaic properties were measured I-V curves, incident photon-to-current (IPCE) efficiencies and impedance analysis by comparison with that of ruthenium dye in same manufacturing condition.

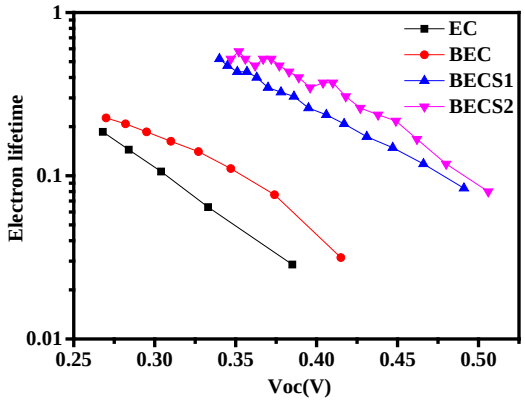

Fig. 1. Electron lifetimes (τ_e) obtained for DSSCs based on organic dyes as a function of open circuit voltage(V_{oc}).

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