The Effect of Fluorescence Lifetime and Energy Level in Small Molecules for Efficient Hybrid Solar Cells

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Two properties make organic semiconductor a good candidate for potential solar cell application: narrow band gap and long photoluminescence lifetime. The former benefit large short circuit current and high open circuit voltage while latter helps to achieve the separation of the photo-excited exciton in limited time. It is disappointing that the fluorescence lifetime of the photosensitizer is rarely studied, although a lot of efforts have been devoted to study the solar absorption and energy levels of the dyes. Herein we designed and synthesized three D- π -A type small molecules, **D-TPA**, **R-TPA** and **C-TPA**, using triphenylamine (TPA) unit as donor unit, thiophene as π -conjugation bridges, alkyl cyanoacetate, dicyanovinyl or rhodanine as acceptor units. By selecting the proper acceptor unit, **D-TPA** shows a narrower band gap and longer fluorescence lifetime than other dyes, and also resulting in an improvement of PCE, which enhances by 9.4% and 23.2% when compared to the **R-TPA** and **C-TPA**, respectively.

Keywords: Hybrid Solar Cells; Small Molecules; Fluorescence Lifetime; Energy Level; Acceptor

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