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Charge Generation and Drift Dynamics in Novel PM6:Y6 Organic Solar Cell Blends

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The enhancement of efficiency and stability in organic solar cells (OSC) is critical for advancing renewable energy technologies. OSC, particularly PM6:Y6 blends, show significant promise due to their potential for high efficiency and improved stability.

The efficiency and stability of OSC are limited by charge carrier generation and their extraction dynamics. Understanding these processes in PM6:Y6 blends is essential, therefore this study addresses the intricate dynamics of these processes within PM6:Y6 OSC blends, containing different donor and acceptor mass ratios by employing transient photocurrent and time-resolved spectroscopy methods.

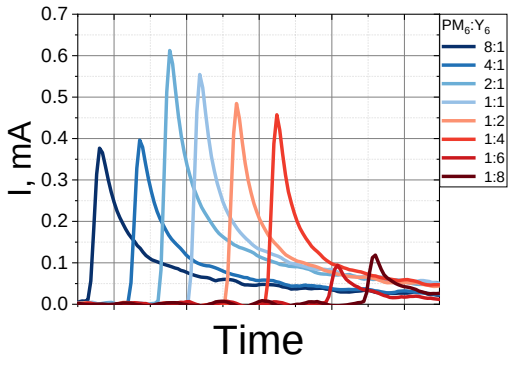

Figure 1. *Photocurrents of different stoichiometry samples.*

We identified a non-linear relationship between photogeneration efficiency and layer stoichiometry, with optimal layer performance observed at specific donor-acceptor mass ratios (2:1 to 1:2). Samples with an excess of acceptor material within the layer exhibited decreased efficiency ostensibly due to exciton localization within acceptor aggregates, while donor-rich layers faced significant carrier concentration reduction due to enhanced recombination and low electron mobility. These findings highlight the importance of precise stoichiometric control and morphological optimization in developing high-performance organic photovoltaics. Our results not only provide a deeper understanding of the charge dynamics in PM6:Y6 blends but also pave the way for the design of next-generation solar cells with superior efficiency and stability.

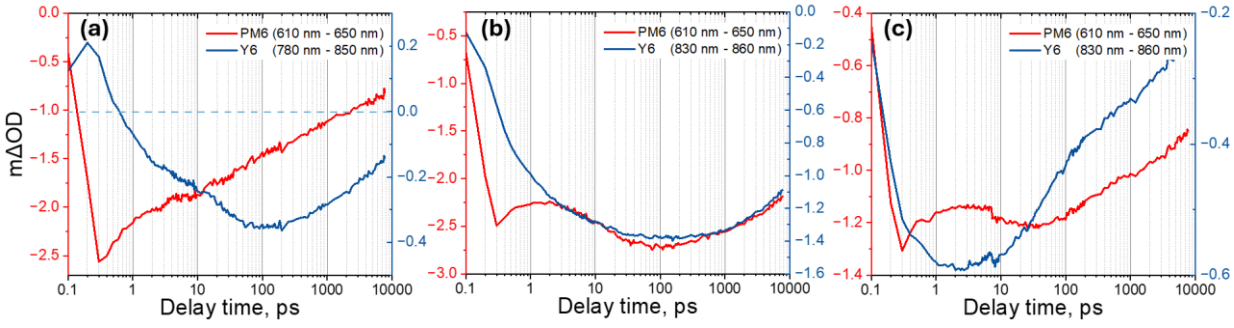

Figure 2. *Integrated pump-probe kinetics of donor and acceptor spectral regions of: (a) donor excess, (c) acceptor excess or (b) transient stoichiometry.*