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In-situ investigation of charge transport/recombination dynamics in organic semiconductors over wide time range at microscopic scale

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Organic semiconductors have garnered a lot of interest in the recent years owing to their easy processibility, tunability to required optical and electrical properties, and of course to their cost-effectiveness. Their use in the organic light-emitting diodes and photovoltaics is already quite promising. However, the charge mobility in these materials is strongly affected by their structural disorder and the energetic disorder introduced by the defects that act as traps to the charge carriers. Depending upon their
physical location, be it interfacial or the bulk of the material; and distribution of energetically favoured level, these traps significantly affect the carrier current flow. In this work, the dynamics of injected/photogenerated charge carriers' recombination and transportation are studied over wide range of time scales. The charged carrier current relaxation dynamics, post pulsed electrical/optical excitation, is studied using time-resolved fluorecence(TRF) in the time range of few tens of picoseconds to few microseconds, while higher time-range dynamics of upto many milliseconds is investigated using the technique called Charge extraction by linearly increasing voltage(CELIV). Polythiophene based polymer P3HT, and the same blend-doped with Phenyl-C61 -Butyric acid Methyl ester(PCBM) molecules and Zinc Oxide nanoparticles are studied at microscopic scale under optical microscopy.

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