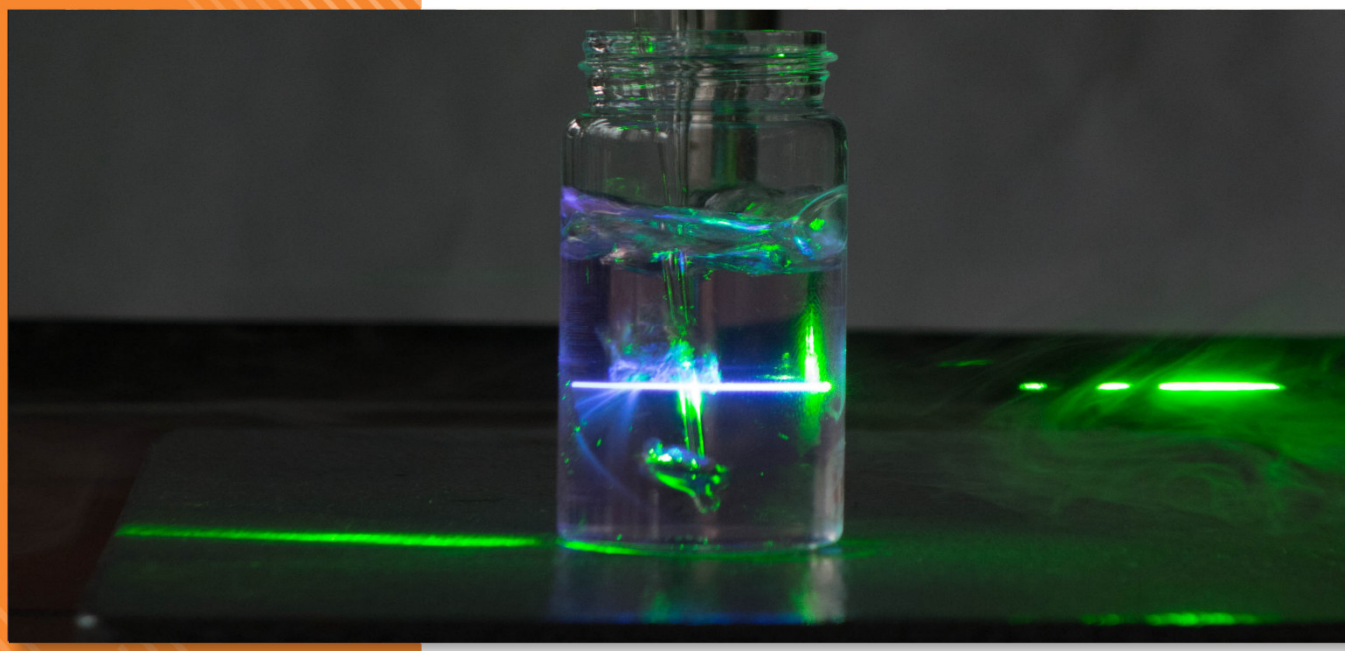
CM@S

BERGISCHE UNIVERSITÄT WUPPERTAL



Organic Solar Cells based on Y-Series Non-Fullerene Acceptors: From Charge Separation to Device Performance

Prof. Dieter Neher
Institute of Physics and Astronomy,
University of Potsdam,
14476 Potsdam,
Germany

Organic solar cells (OSCs) are experiencing a second golden age thanks to the development of novel non-fullerene acceptors (NFAs). These NFAs differ in almost all aspects from the classical fullerene accepetors. One particularly successful type of NFAs are Y-type molecules, with the so-called Y6 as the most prominent acceptor. In blends with the prototypical donor polymer PM6, high efficiencies (>18 %) have been recently achieved in single junction devices, with the perspective to approach the commercially relevant 20 %.

Here, we summarizes our recent understanding of the processes governing the performance of OSCS based on Y6 and related compounds. For PM6:Y6, we find that free charge generation is essentially activationless. This asks for a detailed study of the energetics and morphology of the blend layer. By performing temperature dependent charge transport and recombination studies, we come to a consistent picture of the the density of state distributions for free charges, which allows us to analytically describe the dependence of the open-circuit voltage on temperature and illumination intensity. We conclude that energetic disorder of charge separated states assists free charge formation, where it provides low lying states, while at the same time limiting the open circuit voltage. We finally discuss the role of the free charge recombination in determining the performance of the devices. We find that for most donor-acceptor blends, charge extraction under short circuit (SC) conditions is sufficient to guarantee high short-circuit currents but that the fill factor is limited by a too small diffusion length of the photogenerated charge carriers. Interestingly, this balance seems to be strongly affected by the degree of energetic disorder. This has important consequences for the development of new strategies for the further advancement of the device efficiency.

2. November 2022
10:30 Uhr
Campus Freudenberg
Hörsaal FZH3

www.cmats.uni-wuppertal.de