Summery

The design and development of ternary bulk heterojunction (BHJ) composites requires the investigation of three separate aspects and fundamental topics of organic semiconductors and photovoltaics.
1. Synthesis: The project will start with available polymers for the transport matrix as well as for the sensitizers, and then quickly move over to novel polymers, customized for the purpose of near IR sensitizing, i.e. with various bandgap and smaller variations in the HOMO position.
2. Morphology: The morphology assessment and morphology control of ternary BHJ composites will be another challenge in this project. Polymers which are not completely miscible to each other (and that is the common situation) will show demixing in solution as well as in the solid state. Following Hildebrandt, polymers are miscible to each other if they have comparable intermolecular adhesion forces. Our access to understand and investigate the phase separation mechanisms in ternary systems will be based on an approach similar to Hansen theory. By assessing the solubility parameters for the individual components we investigate the Hansen sphere for a ternary composite.
3. Transport and Charge Transfer: Transport in binary BHJ composites is already a complex process. Within this project we will investigate the transport mechanisms in ternary composites. Specifically, we will explore suitable experimental methods which allow to distinguish between the role of the two polymer and their individual contributions to the hole transport. As important as transport is the charge generation process in the ternary blends. Time resolved pump-probe spectroscopy in the ns regime will be used to understand how the two polymers interact with each other. Most importantly, we want to clarify whether the two polymers may show direct charge transfer, energy transfer, or even have no electronic interactions.