Organic Photovoltaics Engineering

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Organic photovoltaics (OPVs) are among the most promising photovoltaic technologies for long term sustainable energy production. The low-temperature solution processability allows for roll-to-roll mass production on flexible plastic substrates which is expected to lead to a light-weight and low-cost energy production platform, particular attractive for off grid and small power consumer electronics applications. In this talk, I will briefly report our recent efforts on solution processable graphene (SPG) materials development and plasmonic device engineering to significantly enhance the performance and stability of OPVs.

- SPG based materials have been utilized as various components in OPVs, including transparent electrodes, buffer and active layers. In particular, functionalized SPG derivatives, synthesized via efficient functionalization of graphene oxide (GO) using conventional chemical modification routes, are utilized as the electron acceptor material or additive in OPVs[1]. Highly transparent and conductive reduced GO (rGO) films on solid and flexible substrates are utilized as the transparent electrodes. The electrodes are produced in situ, by laser assisted photothermal reduction of spin casted GO films[2-4]. In the same way, doped GO films with tuned work-function are produced by photochlorination. As a proof of concept, highly efficient OPVs, incorporating photochlorinated GO as the buffer layer material are successfully demonstrated, significantly outperforming the reference PEDOT:PSS and pristine GO devices.

- In the second part of my talk, I will address recent advances in the rapidly developing field of plasmonic organic photovoltaics. NPs of various sizes, shapes and configurations have been integrated into OPV cell architecture in order to tune and enhance, in a wavelength-dependent manner, the optical absorption of the respective devices[5]. As a result impressive improvements in the respective device efficiencies were achieved. Particular attention will be paid in our work on the incorporation of uncapped Au, Ag and Al NPs formed by ablation of metallic targets in liquids with pico- and femtosecond laser pulses in the active layer leading to a significant enhancement in both device performance and lifetime[6-11].

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