

Process-structure-property relationship of polymer-fullerene bulk heterojunction films for organic solar cells



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Cuvillier Verlag Mai 2012, 2012. Taschenbuch. Book Condition: Neu. 237x170x19 mm. Neuware - Photovoltaic (PV) is attracting increasing interest as an important contribution to renewable energy supply. Organic photovoltaic (OPV) is a comparable young PV technology with a great potential towards low cost solar power. This is due to the intrinsic advantage of the incorporated organic semiconductors which are soluble. Solution processing allows high throughput coating and printing processes. Hence, energy intensive high temperature and vacuum steps can be avoided which reduces the fabrication costs and keeps energy payback times low. The performance of organic solar cells strongly depends on the structure of the solution cast photoactive layer which comprises a polymer-fullerene blend. The blend structure evolves during the film drying step which has been studied in this thesis. Starting point of this work was the hypothesis that drying process parameters are suitable for systematically tuning the structure formation during drying of solution cast polymer-fullerene films in order to generate optimized structures with improved photovoltaic performance. For the evaluation of this hypothesis the structure formation of the polymer-fullerene system Poly(3-hexylthiophene-2,5-diyl):[6,6]-Phenyl C₆₁-butyric acid methyl ester (P3HT:PCBM) was investigated incorporating i) thin film drying kinetics, ii) phase behavior of polymer-fullerene solutions, iii) structure formation and iv) the drying process-structure-property relationship of solar cells. The generality of the obtained results has been studied in comparison with the behavior of Poly{[4,40-bis(2-ethylhexyl)dithieno(3,2-b;20,30-d)silole]-2,6-diyl-alt-(2,1,3-benzothiadiazole)-4,7-diyl} (PSBTBT). i) Within this thesis a dedicated coating and drying setup was developed which afforded precisely defined coating and drying process conditions as prerequisite for all obtained results. For the first time, the drying behavior of finally a few hundred nanometer thin films could be investigated at five measurement positions with laser reflectometry simultaneously. This allowed the elaboration of a spatially resolved numerical thin film drying model. ii) In conjunction with the measurement and simulation...



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