Abstract

The focus of this work lies in optical simulations of thin film organic-electronic devices, i.e. organic solar cells (OSCs) and organic light emitting diodes (OLEDs). The simulations are based on a transfer matrix (TM) algorithm, that accounts for the dynamical properties of the light in the organic thin film multi layer devices.

In the first part of this thesis different topics in the context of OSCs are covered: A novel method, the so called reverse transfer matrix method, for determining the optical constants of the active material in OSCs is developed. Subsequently the application of optical simulations to multi-junction solar cells (MSCs) is investigated. On the one hand the optical simulations are used to gain deeper insight in the underlying electrical processes of P3HT:$PC_{61}BM$ MSCs, processed via electrospray deposition. On the other hand the TM formalism is used to optimize and realize a complementary absorbing organic tandem solar cell.

In the last part of this thesis an approach for the enhancement of the outcoupling efficiency of OLEDs by introducing a porous hole transport layer with a low refractive index in the OLED stack is presented. The effect is theoretically predicted via optical simulations and is confirmed by measurements of the external quantum efficiency of actual devices.