Abstract

Organic light-emitting diodes (OLEDs) are the organic counterpart to conventional light-emitting diodes (LEDs). In contrast to LEDs, which are based on inorganic crystals, OLEDs consist of organic semiconductors, which enables flexible, paper-thin and transparent light-emitting devices. Although OLEDs represent a relative new technology, they are already well established in today's display market. Especially due to their low weight and low thickness combined with high resolution and high color contrast, OLEDs are commonly used in smartphones and TV screens.

OLED manufacturing can be distinguished between vacuum and solution processing. Currently, commercially available OLED products are vacuum processed, which is cost-intensive. Solution processing potentially reduces production costs due to high throughput manufacturing, but brings along new challenges as well.

This thesis concentrates on solution-processable materials for the application in OLEDs. The first part of this thesis addresses layer engineering with the focus on polymerization and molecular stacking within a layer. In the former case, an on-substrate polyazomethine formation, creating a solvent resistant light-emitting layer is introduced. And in the latter case, a self-assembling bisphenazin derivative is investigated with special regards on its conductivity and stacking behavior. Here, the domain size of the bisphenazin could be adjusted by modifying the process parameters.

The second part of this thesis presents different OLED emitter materials. First, a platinum porphyrin dye (PPD), which is used as a near-infrared (NIR) emitter. With PPD an EQE of 1.2% could be reached, which is so far, to the best of my knowledge, the highest EQE published for solution-processed NIR OLEDs.

Secondly, the optoelectronic properties of so-called dual emitter, i.e. showing simultaneously fluorescence and phosphorescence, is studied. For this, two phenazine derivatives and two ladder-type poly(para-phenylene) (LPPP) derivatives are investigated. The phenazine derivatives show dependence of their electroluminescence spectrum and there host:guest ratio, which might be due to stacking and annihilation processes.

For the LPPP derivatives, besides fluorescence and phosphorescence, delayed fluorescence and excimer emission could be observed. Moreover, the magnetoluminescence of phenyl-substituted LPPP is investigated, showing an anticorrelation between the fluorescence and phosphorescence intensities.