Abstract

Demand from the society for a better and more sophisticated technology has been a challenge due to limited energy resources which has led to a competition for manufacturing of eco-friendly, energy saving yet high performance revealing products. Since emergence of semiconductors as a substitution to common metals in electronics, old fashioned tungsten lamps have been replaced by low energy consumption and still high performance products; light emitting diodes (LEDs). Organic counterpart of this new household lighting products, known as organic light emitting diodes (OLEDs), have attracted companies owing to its low-cost production and easy-to-tune optical properties. Although the device architecture plays a crucial role in the device efficiency, the main challenge is to emit a photon per injected charge. Until ten years ago, organic emitters were believed to produce light from only 25% of injected charge carriers. Thanks to today's photophysical understanding, in which excitons in spin forbidden state can populate spin allowed state, OLEDs can show competitive results in comparison to the efficient LEDs.

The first part of this thesis will be an investigation on crosslinkable anthracene derivative organic emitters exhibit triplet-triplet annihilation and their utilization in solution processable OLEDs. Examination on their photophysical properties will indicate the reactions play role in the excited state. By combination of blue and yellow emitting molecules, white OLEDs (WOLEDs) will be manufactured. The WOLEDs will be studied in terms of both device performance and color quality. Lastly, time resolved electroluminescence spectra of the devices will be measured to determine contribution of delay fluorescence process on the device efficiency.

The second and third part will focus on emitters revealing thermally activated delayed fluorescence (TADF). Two different types of emitters, a silver (I) complex and a spirofluorene derivative, will be analysed regarding their emission behaviour under different temperatures and the singlet and triplet energy splitting. Different approaches will be demonstrated to identify the energy splitting and their applicability on these different types of emitters will be discussed. In order to utilize the TADF type of emitter in a solution processable OLED, an emitter bearing donor and acceptor units will be used. After the characterization of the device, its optical properties and device performance in a host molecule, as well as contribution of the delay mechanism on the device performance, will

be investigated. At the end, the effect of these two photophysical mechanisms on the device performances will be compared and discussed.