

Abstract

The main topic of this work is the crosslinking of oxetane-functionalized semiconducting polymers to fabricate solution processed multilayer organic light emitting diodes (OLED). There already exist several methods to initiate the cationic ring-opening polymerization (CROP) that takes place. The theoretical part of this work includes a detailed comparison. The experimental part focuses on the current-induced crosslinking (CHIX), discovered by M. Gather and P. Zacharias and the PEDOT-initiated crosslinking (PIX) introduced by A. Köhnen.

The first part of this work is about the initiation of the CROP by passing current through devices consisting of a hole-transporting material (triphenyldiamin-derivate, TPD) between two electrodes. For this research, the crosslinking level of bipolar devices and ones with only positive respectively negative charge carriers was analyzed. Only the injected positive charge carriers (radical cations) are able to start the crosslinking. The mechanism is the same as already known from for example the oxidative crosslinking method. Electrons just effect localisation during the crosslinking process and thus accelerate it. The temperature as well as the injected charge influence the crosslinking level. In addition, by using a specific design of the cathode, it is easily possible to structure the material.

The aim of the second part of this work is to optimize the PIX method and to improve its reproducibility. Therefore, a systematic investigation about parameters that could influence the process was performed. Furthermore it was necessary to analyze, how the parameters, accelerating the crosslinking, affect the OLED performance. The results have shown that it is mostly required to compromise between fast crosslinking and a high OLED efficiency. Within the context of these studies, several new findings about the mechanism of the PEDOT-initiated crosslinking process were discovered and the process itself is reproducible now.

Both crosslinking methods, focused on in this work, increase the lifetime of multilayer OLEDs compared to the commonly used photochemically-induced crosslinking by factor 3. The maximal efficiency of the devices is comparable.