Abstract

In this work, a detailed study providing insight into the fabrication of microdisplays containing polymeric, top-emitting OLEDs, is presented. Two different device architectures are demonstrated which can be used as active layers in microdisplays. These possess alternative layer sequences compared to commercially available microdisplays. Due to this new design, the performance limitations of common microdisplays regarding color purity and operating brightness level can be circumvented. The limitations are a result of the device architecture, in which white light of a back-light source is converted to red, green and blue light, requiring colorfilters. In case of the presented OLED-based microdisplays, the pixels (sub-pixels) can be fabricated via direct photo-patterning of the active materials, offering the opportunity of light and color generation within the active OLED layer stack.

This feature is showcased in the first approach by using individually crosslinkable blends of RGB-emitting polymers. These blends represent a material system which offers photo-patternability of the emitting layers without requiring crosslinkable moieties directly attached to these materials, as an external crosslinker is used. Therefore, several cost and synthetic advantages are secured.

The second approach demonstrates light and color generation within the active OLED layers via optical pathlength (i.e. layer thickness) tuning of a microcavity containing a crosslinkable hole conducting unit with variable layer thickness and a white-light emitting polymer. Both types of OLEDs presented here allow for high-level color performance matching the sRGB color space specifications. Furthermore, they allow for significantly lower loss factors, compared to commercially available devices.

As a proof of principle, microdisplays have been fabricated and characterized as individual RGB-polymer devices. Here, a three step photo-patterning process was developed and applied, resulting in high-resolution (sub-pixel size of $5.5 \times 7.5\,\mu m$) and high-level alignment accuracy (in sub-µm range) of the sub-pixels. Finally, the first electrically operable microdisplay devices with photo-patterned sub-pixels have been realized.