Fabrication and characterization of flexible OLED with printing techniques

Abstract

The need to replace the toxic, rare and expensive materials of producing solid state LED as light sources with the alternative carbon-based C materials led to the emergence of organic LED (OLED) technology. In recent years, emphasis has been placed on polymeric materials for light emission from soft material sources (PLED). The physical properties of the polymers have paved the way for a wealth of reports of experimental development and optimization of flexible devices with printed light emission and carrier treatment layers without, however, being totally exhausted by cost-cutting and small-scale vacuum techniques.

In this study, we investigate and characterize a series of polymeric (innovative and commercial) broadcasting materials, an extensive range of colors, by using Photoluminescence Spectroscopy (PL) and Spectroscopic Ellipsometry (SE) techniques. By developing standard rigid PLED devices we were able to record the Electroluminescence (EL) spectra of each material revealing similarities and differences with the respective PL. We recorded the electrical characteristics for each polymer and copolymer in order to tune white light emission. With the aim of SE we have determined the ideal thicknesses of the involved layers and by Atomic Force Microscopy we characterized the surface morphology of each layer.

Moving one step further, we investigated and replaced those films that were blocking the full transfer of PLED growth to large-scale printing techniques such as Slot Die. Using mainly the Slot Die technique we developed the first flexible fully-printed PLEDs that were characterized in the same way as standard ones.

The results showed that it is possible to achieve the efficiency of the standard PLED devices on rigid and flexible substrates as well. For the commercial emitting materials luminance reached 3500 cd/m^2, a value that surpasses the standards for flexible OLEDs fabricated via printing techniques in ambient conditions. Furthermore, extraction of pure white light was achieved by color tuning of a

terpolymer, with chromatic coordinates of (0.33, 0.34), a big step when it comes to indoor lightning applications.

Key words: PLED, Organic Electronics, Printed Electronics, Fluorescent Polymers, R2R processes, Slot Die Coating,