

Organic Light-Emitting Devices (OLED)

OLEDs offer a variety of new applications since they are true two-dimensional light sources which can be fabricated even on flexible substrates. Furthermore, they have a large potential for being produced by low-cost and high-throughput roll-to-roll processes such as printing. CSEM focuses on solution processed polymer LEDs (PLEDs) using a broad variety of deposition techniques ranging from spin-coating to ink-jet and gravure-printing.

The Concept

PLEDs may consist of multi-component mixtures of dedicated materials in order to adjust the desired properties. Most common goals of formulation optimization include: maximizing efficiency, minimizing driving voltage, maximizing device lifetime, and adjusting the emitting color of the PLED. A promising approach is a host/guest-system, which consists of the matrix material (host) and an emitter material (guest) in small concentrations. Further functional materials can be used to improve the performance.

Figure 1 shows efficiency values of devices with a fixed yellowish/green emitter concentration of 5%. For this material system PBD concentrations above 20% improve the efficiency but only if at the same time the TPD concentration is in the range of 5-10%.

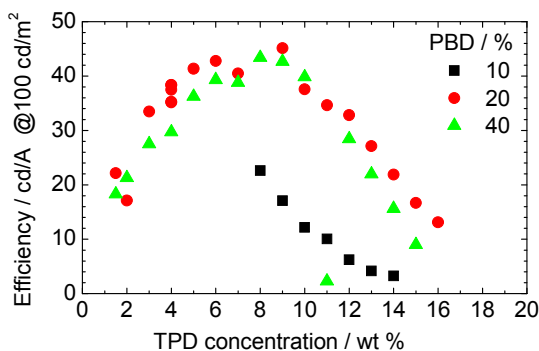


Figure 1 Dependence of PLED efficiency in dependence of hole-transporter (TPD) and electron-transporter (PBD) concentration

The Technology

CSEM has a wide range of OLED processing capabilities situated in a central clean room facility. Processing capabilities include automated substrate washing, spin-coating in inert atmosphere, metal evaporation and encapsulation with getter materials.

A modified [pipetting-robot](#) together with an automated opto-electrical characterization system allows speeding up material screening and formulation optimization of solvent processed organic LEDs. A concentration sweep of

individual blend components can quickly reveal the ideal blend ratio for optimum Polymer LED (PLEDs) composition (see Figure 1).

On the characterization side CSEM has a fluorimeter measuring in inert atmosphere, I-V characterization, luminance and spectral measurement, admittance spectroscopy and device lifetime measurement both inside and outside of glovebox. Besides standard microscopy and SEM, our division has access to MALDI, TEM and AFM. Other methods of interest include phosphorescent lifetime measurement, angular EL dependence setup and calcium test. The later is used to check the quality of the encapsulation against water and oxygen.

In terms of deposition methods, CSEM has capabilities for spin-coating, inkjet and gravure printing. CSEM also has know-how in innovative multilayer geometries for polymer LEDs, including multiple cross-linked functional layers.

Applications

Applications are wide-ranging from information displays and smart packaging to lighting and even sensors. Figure 2 shows an example of a patterned OLED indicator used in a push button application.

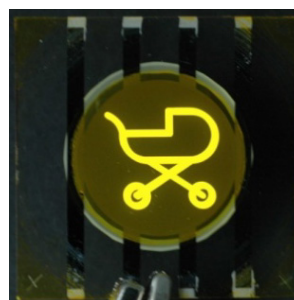


Figure 2 Example of OLED fabricated at CSEM for a push-button application

Other examples include [RF-powered OLED](#) that could potentially find applications in smart packaging.