csem centre suisse d'électronique et de microtechnique

info@csem.ch
www.csem.ch

RF-Driven OLEDs for Mobile Applications

Organic light-emitting devices (OLEDs) offer a variety of new applications since they are true two-dimensional light sources which can be fabricated even on flexible substrates. They have a large potential for being produced by low-cost and high-throughput roll-to-roll processes such as printing. This would enable applications like indicators or low information content displays on packages or tickets. Such devices can be powered by energy transferred via radio-frequency from mobile phones.

The Concept

Organic light-emitting diodes started as fundamental research topic on organic crystals in the 1950s and 1960s. A big step forward was reported in the late 1980s and early 1990s when research groups reported electroluminescence of evaporated thin films of small molecules and solution processed polymers. Printing of solution processed OLEDs is believed to bring costs down substantially. Inkjet printing, for example, offers the highest flexibility since digital images can directly be transferred into patterns on various substrates. Techniques like screen-, flexo- or especially gravure printing are higher throughput methods which will result in reduced manufacturing cost for mass-production. OLEDs can as well be fabricated on flexible plastic substrates (typically PET), thus enabling many new applications. A big advantage of plastic substrates over glass substrates, especially for mobile applications, is their lower weight, their flexibility and that they are basically not fragile. An open question is the power supply to such devices. Flexible and thin film batteries exist on the market and are further developed, however, their capacity is still limited. Power could also be supplied in a different way. For instance, nowadays, mobile phones are omnipresent and provide an ideal mobile power supply. Wireless energy transfer is feasible using a suitable transmitter unit and an appropriate antenna as receiver.

Figure 1: NFC mobile phone, antenna and OLED

The Technology

Figure 1 shows a mobile phone, an RF-antenna with a rectifying diode and capacitors, and a small illuminated OLED test pixel (4 mm^2).The used mobile phone has a special near field communication (NFC) option which transmits at 13.56 MHz. The antenna has the size of a credit card and can also be flexible which would facilitate the integration into a package. The size and shape of the antenna depends on the frequency band used.

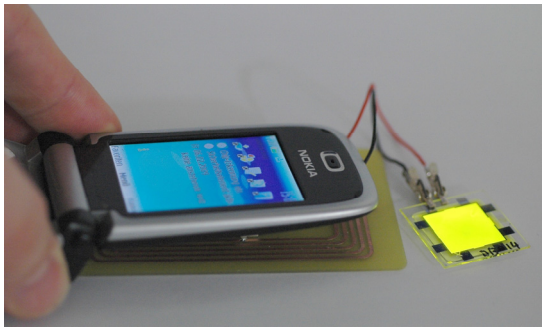

Figure 2: RF-driven OLED pixel (active area 2.56 cm^2)

Figure 2 shows a larger pixel with a size of more than 2.5 cm^2. The NFC unit uses pulsed mode with a repetition rate of about 3 pulses per second. A luminance higher than 500 cd/m^2 is achieved, which is clearly visible under normal daylight conditions. This corresponds to a peak current of about 25 mA. Depending on the load of the device, voltages as high as 20 V can be generated.

Applications

The RF-powered OLED is just one example of many possible new applications using indicators or simple displays on packages, tickets or similar products. In principle, all components can be printed: the antenna, the diodes, the capacitors and the OLED element itself. For more complex applications even solar cells (as power supply) and transistors (as switches and logic) can be printed.

One important step towards such future applications is the manufacturing of fully printed OLED elements in a continuous roll-to-roll (R2R) process. CSEM's pipetting robot helps to speed up screening and optimization of materials and devices. Printed organic electronics is a multi-disciplinary field where the chemical industries with synthesis, printing equipment manufacturers, device physicists and engineers as well as system designers have to work closely together in order to enter this attractive and huge market with innovative new products.