Converging Technologies Speed Up OLED Development

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OLED technology is already being used in displays for small consumer products such as PDAs, cell phones, and digital cameras, but there is still a lot of development ahead. Organic LED technology has not reached the performance and production efficiencies that will make them suitable for widespread use in large area displays or with high quality video. The convergence of new materials, production technologies, and refined test solutions should accelerate OLED development over the next couple of years.

In its evolution from LCDs to new organic and polymer LED technologies, the Flat Panel Display (FPD) industry is grappling with test issues in both R&D and production. These issues apply to both small molecule OLEDs and polymer (PLED) technologies. For new designs, material lifetime is a major issue at the R&D stage, and device reliability is always a concern in production. Effective testing is required to fully characterize materials and devices and rapidly move them from R&D into production.

New production technologies are also being investigated for use with OLEDs and PLEDs. For example, OLED devices based on small-molecule technology are compatible with most semiconductor processing techniques. Now "printable electronics" may alter the way these FPDs are made. Soft lithography techniques such as microcontact printing may make it possible to improve the resolution and image definition of OLED displays. This or a similar technology could reduce the cost of producing active matrix FPDs by depositing thin film transistors (TFTs) on the same substrate as the OLEDs. These TFTs may also be organic based instead of using the present CMOS technology, which should further simplify production.

New materials, continually shrinking device structures, and revolutionary processes are combining to increase the importance of testing at all stages of OLED development. At the same time, measurements have become more demanding. Due to the disordered nature of organic material, OLEDs have low carrier mobilities. The resulting formation of space charges produces numerous transient effects, some of which cover multiple orders of magnitude in time. To characterize the electroluminescence and phosphorescence mechanisms, instruments must provide high sensitivity and precision. Electrical measurements at femtoamp and microvolt levels are common.

In production, FPD test systems typically measure junction characteristics of the OLED devices and may also perform tests on the TFTs. The instrumentation and test methodology must accommodate the relatively high capacitance of these devices without adding excessive test time. Since OLEDs are active light-emitting devices, it is important to characterize their light-current-voltage (LIV) properties under both DC and pulsed DC operation. With the large number of pixels arranged in rows and columns, a switching matrix is required to speed up FPD testing. For best results and lowest cost, each test system is usually tailored to a specific display technology and physical configuration. By matching test variables as closely as possible to actual operating conditions, accurate modeling and lifetime predictions are possible. KEITHLEY

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