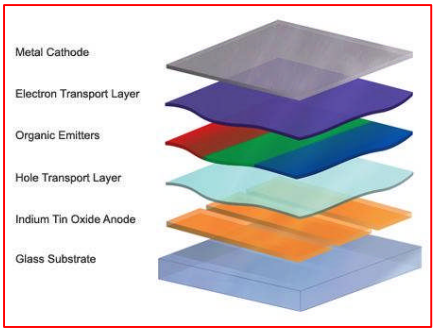
FLAT PANEL DISPLAYS - PHOTONICS NEWSLETTER

April 2007 - Ken Gilleo - Ken@ET-Trends.com

MARKET & BUSINESS INFORMATION

Big Screen with Small Device - There are at least three approaches for improved portable viewing; roll-up screens, projectors and eyeglass wearable displays. There's plenty of action in the flexible display area, but all-plastic displays are only in prototype today and the presently targeted products are rigid displays at lower cost. Wearable displays are on the market, but cost is high and resolution is low. But a breakthrough in near-eye display technology could change things rapidly. The 3rd is projection, with the same technology used by Texas Instruments for their DLP **optical-MEMS** (MOEMS) technology. PricewaterhouseCoopers predicts that micro-projectors will bring the big-screen experience to tiny devices in about 2-years.

Hard Times for Some OLED Makers - Univision Technology (Taiwan) has resumed operations at some of its production lines and now has approximately 60-70% capacity back on line. Univision's equipment was seized under a court order after it failed to settle overdue payments with suppliers at the end of 2006. Following the seizures, the company asked its employees to take leave while operations remained idle. Additionally, the company has temporarily **cut its OLED production** in half. In February, the company restarted operations and has seen some orders due to the limited number of suppliers in the Taiwan OLED industry. However, in order to lower operation costs, Univision has reduced its workforce to 190 employees, compared to the level of 600 it had in the past, noted the company. Univision plans to increase PC-related and car-use OLED shipments and to boost revenues from these two segments such that they account for one third of its annual sales in 2007, projected the company. Handsets and MP3 players are now also major applications, it added. Several Taiwan OLED suppliers have decided to phase out of the market due to strong competition from TFT-LCD technology. **Opto Tech closed** down its OLED business earlier in 2007 and during the middle of 2006 and AU Optronics (AUO) was reportedly to give up on OLED. Chi Mei Optoelectronics (CMO) will decide on the future of its OLED business at the end of 2007. RiTdisplay is the top OLED supplier in Taiwan at present. Taiwan shipped about 25.3 million OLED panels in 2006 while **South Korea topped the worldwide market** by shipping 28.6 million units (from Displaybank).



OLED vs. LCD - The hard times for OLDED just discussed, is mostly about technology and manufacturing costs. With more fourth-generation (4G) LCD plants entering production of small- to medium-size panels, OLED panel makers feel the greatest impact. RiTdisplay and Univision Technology, the major Taiwan-based OLED panel makers face serious losses. The stocks of both companies stopped trading on the Taiwan Stock Exchange (TSE) in December of 2006 and in February 2007, respectively. In addition, RiTdisplay saw a major shareholder back-out last November, with parent company Ritek no longer holding a majoring stake in RiTdisplay. Univision

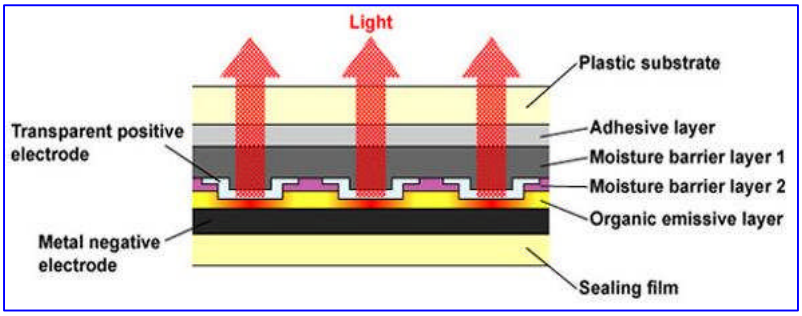
had its equipment seized by court order after it failed to settle overdue payments with suppliers, and the company asked its employees to take leave while operations remained idle. **Here's the issue.** OLED is constrained to small- to medium-size applications by *technology limitations*. OLED is difficult to apply to large-size devices while the entry barrier for active-matrix (AM) OLED panels is higher than that for PM OLED panels. As a result, Taiwan-based makers mostly focus on PM OLED panels, most of which are of small sizes, with the maximum size ranging from two to 3.2 inches while the mainstream segment lies in the 1.8-inch-and-under one for mobile phones and MP3 players. PM OLED production already exceeds 90% yield rates. Nevertheless, PM OLED panel technology is still only applied on low-end sub-displays for mobile phones due to specification constraints. But ***OLED is not competitive against TFT LCD in capacity level and pricing***. In addition, when large-size panel production moved to more advanced TFT LCD plants in 2006, more and more 4G-and-under TFT LCD plants were dedicated to small-to-medium-size panels. PM OLED makers tried competing against TFT LCD makers in terms of price, but suffered from losses. The PM OLED makers probably aim at niche markets to be free from a price war. PM OLED makers are caught between an inability to enter the high-end market and competition from color STN (CSTN) LCD makers in the low-end segment. Taiwan-based companies such as Teco Optronics Opto Tech have ended production of the segment while Samsung SDI and LG Electronics (LGE) are moving to AM OLED. It remains to be seen whether the rest, which include RiTdisplay and Univision, will be able to find a focus to remain in the game.

E-paper Display Production News - (Electronic News) - Nemoptic, an e-paper display manufacturer, is **moving into high volume** production with help from Seiko Instruments (SII). Under the deal, Nemoptic gives SII its display technology in return for SII giving Nemoptic manufacturing capacity. There is no other **bistable technology** capable of supplying the electronic paper and no one else can achieve full compatibility this type of manufacturing. SII will make the displays in its existing, full depreciated, STN (Super-Twisted Nematic) display factory and that will drop manufacturing costs. This is a very generic technology capable of 32 grey levels, 32,000 colors, transmissive or reflective, with passive or active addressing, and on plastic. The technology is suitable for a bendable or a rollable display, but Nemoptic is currently working on the bendable option that is a couple of years from commercialization. [***The bistable flexible display area continues to see a lot of action in all kinds of form factors, and it appears to be a unique and valuable technology with a future - KB]***

Signage and Pro Display to Rise 600% by 2011 - Digital signage and professional display makers are facing mediocre revenue today, but fast-rising unit shipments will turn this around (iSuppli). The digital signage and professional displays market is set to grow to $14.6 billion by 2011; CAGR of 9.8%. Unit growth in the digital signage market will hit 22.7-million units by 2011; CAGR of 42.2%. The main reason for weak revenue growth is the substantial price declines occurring in display technology ironically caused by improvements in manufacturing processes and maturation of technology. This steep decline in prices for traditional signage products occurred with the adoption of electronic displays. However, digital display price competition is

less intense and margins are much healthier in the digital signage market than other fiercely competitive display areas like monitors and TVs; companies are rapidly entering signage.
Users of signage and professional displays are retail and department stores, fast-food restaurants, museums, hotels, auditoriums, trade shows and retail banks. Digital is expected to provide more opportunities for display manufacturers to sell products for higher margins. The biggest application for the signage / pro displays continues to be indoor that amounted to $704-million in Q4-2006 and is forecasted to reach $7.2 billion in 2011; nearly half of the global signage market. This segment is also benefiting from the upside cycle of the hospitality industry after many years of downturn. Profiting from healthier revenues such as luxury and super-upscale hotels has mostly shifted from traditional CRTs to sophisticated flat-panel displays (FPD) for guest rooms. Other hotels are also following this trend to FPD that is being helped by lower prices. Another major factor driving the hospitality industry is the need of hotel operators to differentiate their brands and to enhance customer satisfaction by providing new in-room entertainment services such HDTV and video games. The hospitality segment will continue to generate the largest sales volume in the indoor venues signage segment. Retail-signage products are becoming popular and should reach $2.8-billion by 2011, making it the second-largest signage market after indoor venues. **Retail-signage** is driven by rapid product revisions, retail feature proliferation, lack of a knowledgeable sales staff, and the need to communicate ads / sales to customers. While LED video display will be the technology of choice for outdoor billboards and signs, direct-view PDP (plasma display panel), LCD and rear-projection video walls will compete in the indoor retail signage space.

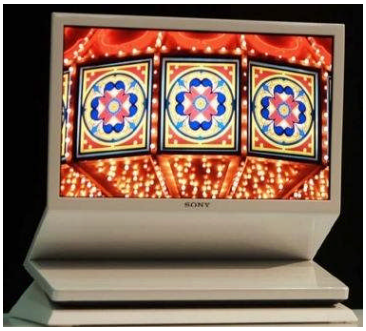
TECHNOLOGY



Toshiba Matsushita Display (TMD) announced development of a 20.8-inch prototype **Organic EL** (electroluminescence) display, claimed as the largest panel that combines polymer organic EL materials and low-temperature poly-silicon (p-Si) TFT. The display boasts 1280 x 768 WXGA resolution and with about 17-million colors, but TMD does not intend to disclose detailed information including its luminance, contrast, lifecycle. The company said the display uses **inkjet printing** for coating red (R), green (G) and blue (B) **polymer organic EL materials** with no filter color adjustment. TMD developed a new top emission structure to boost the efficiency of distributing light produced from the light-emitting layers, thus leading to higher luminance and lower power compared to its previous model. In the large screen size organic EL display segment, TMD announced a 17-inch prototype in 2002. The company said the latest prototype was developed in order to examine feasibility of manufacturing process optimized for

large panels. Another goal is facilitating the development of polymer organic EL materials with higher durability, compared to low molecular weight organic EL materials. TMD is already mass-producing 2- to 3.5-inch OLED (organic light-emitting diode) panels made from low molecular weight organic EL materials. The company stated that this work partly belongs to the Advanced Organic Device Project that Japan's New Energy and Industrial Technology Development Organization (NEDO) contracted to Optoelectronic Industry and Technology Development Association (OITDA). TMD is taking aim at the $35-billion flat TV market, currently dominated by LCD and plasma, and plans to ship an OLED display in 2009; target size will be 30-inches. While Toshiba doesn't expect to compete directly against Sony, they believe their technology's superiority, including lower manufacturing costs, and better viewing angles and contrast. **Sony**, another large organic EL display, has announced a 27-inch (69 cm diagonal) display using low molecular weight organic EL materials before [see below].

PRODUCTS



Sony to Sell Ultra-thin OLED TVs - While other OLED makers may be faltering, **Sony remains aggressive**. *[Sony 27" OLED prototype shown at right.*] Sony plans to start selling **ultra-thin TVs using OLED** technology this year, opting to become the first to market with a TV using this type of display. OLEDs can produce bright, colorful images and no backlight is required allowing for a thinner panel. These **energy-efficient** OLED panels are also good at reproducing fast-moving images. Sony has demo'd a tiny 11-inch OLED TV. Some say that LCD and plasma displays look faded in comparison. OLED displays are already used in digital cameras, cellphones and other devices with relatively small panels. But cost and technology hurdles have so far prevented them from being mass-produced for use in larger equipment such as TVs. The OLED TV to be launched this year will be made by ST Liquid Crystal Display Corp., a joint venture between Sony and Toyota Industries. Sony has invested aggressively in LCD technology, is now the world's largest player in the LCD TV market, and makes big LCD panels in a joint venture with South Korea's Samsung Electronics. Sony will begin by mass-producing about 1,000 of the 11-inch OLED sets a month. Today, OLED sets are very expensive but Sony will begin first by marketing the OLED TVs as a premium status symbol product. Sony has slightly exceeded its target of selling 6 million LCD TVs in the business year ended last month, and has targeted 10 million units for 2007. Other companies investing in OLED displays include Seiko Epson Corp., Canon Inc., Samsung and a joint venture between Toshiba and Matsushita [see below].

Apple to Go LED Backlighting - Apple plans to launch Macs featuring LED backlight technology in 2007 as it strives for "a greener Apple". The use of LED backlighting instead of CCFL (cold cathode fluorescent lamp) to illuminate its LCD panels would enable Apple to eliminate use of mercury in the manufacture of its products. Apple's comments indicate that it would most likely be those that feature smaller LCD panel sizes due to technical constraints. Apple's current Mac product lineup comprises of panel sizes from 13-inch in the MacBook notebook range up to 24-inch in the iMac desktop. Apple also has a 30-inch Cinema high-definition (HD) display. Apple eventually plans to transition to LED backlight technology in all displays when possible.