FLAT PANEL DISPLAYS - PHOTONICS NEWSLETTER

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

MARKET & BUSINESS INFORMATION

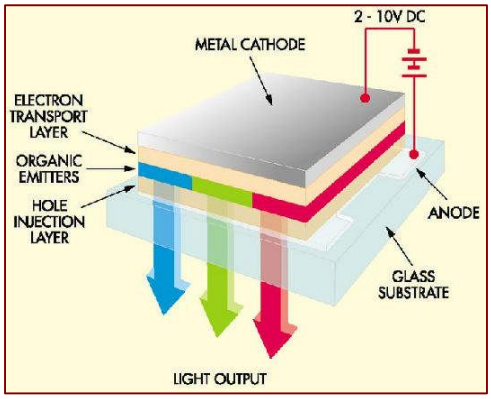
Upward for LCD Sales - The global shipment forecast for LCD TV panels in 2007 is now set at 75.3-million with expected shipments to represent a 42% growth over 2006. The shipments should exceed 100-million units in 2008 and further increase to 172-million units by 2011, when the penetration rate of LCD TVs from the total TVs shipped during the year will reach 65%.

Taiwan will have 80% of the global LCD monitor market in 2007 - Taiwan makers will ship 123-million LCD monitors this year, up from 102 million in 2006, as Korean LCD monitor makers including Samsung and LG Electronics (LGE) are phasing out their OEM/ODM business. With the increased shipments, Taiwan will grab more than 80% of the global market for the first time (DigiTimes).

The DLP Captured More than Half the Projector Market in 2006 - (DigiTimes) Digital Light Processing (DLP) technology accounted for more than half the global projector market in 2006. In addition, the technology topped the 1080p and 50-inch-and-above TV markets in North America in 2006. The global projector market grew 25% in 2006, with growth in the consumer segment being especially strong. That segment will grow at a 70% compound annual growth rate (CAGR) from 2006 to 2010, a rate much higher than the CAGRs for PDP (plasma display panel) TV (10%) and LCD TV (36%). The 40-inch-and-above TV market in North America grew 25% in 2006, with the 1080p segment jumping significantly during the year.

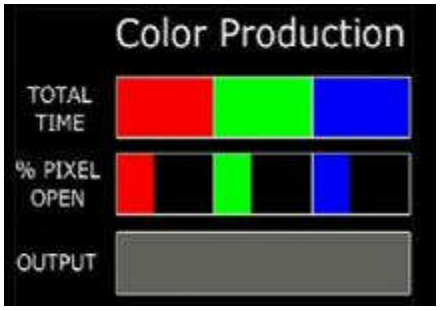
TECHNOLOGY

OLED Future - The OLED market will reach $1.4-billion in 2007, is predicted to hit $10.9-billion by 2012, and grow to $15.5-billion by 2014 (NanoMarkets). OLEDs can be made into thin sheets of polymer that emit bright light when an electrical current is applied and are already used on the outer screen of many clam-shell cell phones, a few MP3 players, an electric razor, and a Kodak camera. Kodak was one of the first to develop a specific kind of OLED technology. Sony is another major company that is touting OLEDs as the next big thing in flat-screen televisions. General Electric is using them to develop more energy-efficient lighting fixtures and windows. Their thinness and promise of low power consumption also make OLEDs ideal for signs, as well as computer and laptop monitors. The attraction for OLEDs is that OLEDs are very bright and attractive to look at. The displays require no backlighting, a distinct advantage over LCDs; this makes them more energy-efficient and less of a drain on batteries. Also, OLEDs may prove cheaper to manufacture. Currently,



OLED displays are not as complicated to produce as LCD displays, though the processes are similar. However, OLED displays will probably be printed with or ink-jet printers in the future, using roll-to-roll process, like membrane switches and other PTF products. Sony has said that 2008 could see some OLED televisions available to consumers. But since companies have invested heavily in LCD manufacturing plants, OLED will face fierce competition Yet, we can expect to see OLEDs as the main screens on mobile phones; their fast switching rates is ideal for video - the big play in mobile products. We can expect revenue for OLED displays used in mobile phones and handhelds to be about $7.2 billion by 2014 and to have a significant impact on lighting; market for could exceed $1 billion by 2014; a 25-$cm^2$ panel of OLEDs can generate about 25 to 31 lumens per watt, compared with the 10 to 15 lumens per watt given off by an incandescent light bulb. There are plenty of technical challenges/opportunities: better packaging, especially water resistance, and optimized manufacturing by roll-to-roll printing *[Opportunities for materials and equipment]*.

OLED Organic Encapsulation - GE & Tokki will Develop Encapsulation Film for OLEDs - GE Global Research signed an agreement with Tokyo-based OLED manufacturing equipment supplier Tokki Corp. to develop PECVD ***film encapsulation technology*** and equipment for manufacturing OLED flat panel displays. The equipment based on the technology resulting from this collaboration is expected to serve as the foundation for the future manufacturing and sale of glass-based displays that are thinner in design and much lower in cost. GE will license its patented PECVD film encapsulation process to Tokki for use in the company's OLED manufacturing equipment. Since OLED devices require a high degree of hermetic sealing or "encapsulation," as moisture and oxygen can impede the devices' functionality, the encapsulation technology is seen as a critical component for enabling future OLED devices and process technology that are much thinner in design, while still protected from environmental degradation, the companies noted. *[Opportunities for organics, maybe getters/}*



UniPixel Displays (Woodlands, TX) has developed Time Multiplexed Optical Shutter (TMOS) technology to address display requirements in avionics applications, particularly heads-down cockpit deployments. The company has engineering prototypes and expects to have the display in a television application by Q4-07. UniPixel has been working with Xerox Palo Alto Research Center (Parc), Lockheed and Sandia National Laboratories in developing TMOS. The company has completed $12-million in private financing. UniPixel uses a unique TMOS approach to color display technology. Traditional displays use three closely spaced dots displaying different intensities of red, green and blue to create one color – somewhat like the dots that comprise a printed image. Because these dots are so close together, the human eye perceives them as a single color. This is called "spatial additive color." UniPixel is based on a "temporal additive color." Short bursts of red, green and blue light are emitted through the same dot so quickly that the eye also sees them as a single color. But in this case, different durations of red, green and blue create different shades and hues. Each dot can display a full range of colors resulting in more vivid, intense images. Color is smoother and more lifelike. Manufacturing is simplified. But the path to a commercial product may not be smooth. The UniPixel proprietary sandwich can be made with roll-to-roll processing and that's a big plus, but uniformity and cost still have to be answered. Even if the answers to all these questions are reasonably positive, it typically takes a long time for system makers to assure themselves they want to take a flyer on a new technology and for panel makers to sign on. *[Opportunity for printing and inks?]*

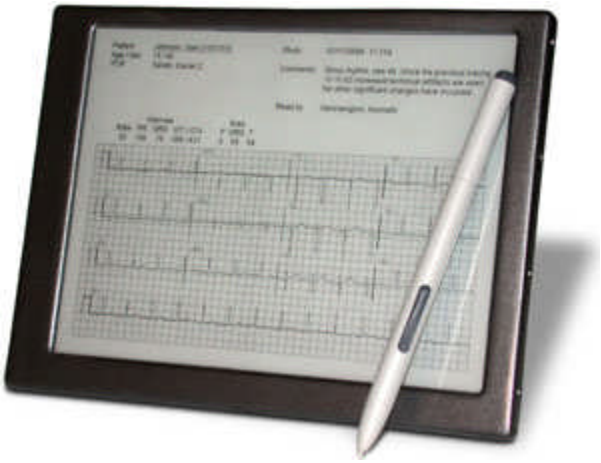
PRODUCTS

TI shows projection image for mobile phones - Texas Instruments (TI) is exhibiting the potential of DLP (digital light processing) for mobile device applications. TI is demonstrating a prototype DLP pico-projector small enough to fit on a fingertip, the company said in a recent press release. This prototype is capable of displaying an image about the size of a sheet of paper (8.5×11-inches) in ambient light conditions. The DLP being demonstrated has a HVGA (640×240) resolution, the company indicated. This is two times the resolution of a typical mobile phone screen. The projector contains three lasers, a DLP chip and a power supply and measures about 1.5-inches in length. With the projector, the mobile phone can beam DVD-quality video onto a screen or a wall, CNET wrote, adding that the chip inside the phone could drive images for a widescreen TV. The DLP pico-prototype further advances TI's mobile projection technology, building on the 2006 introduction of DLP-based pocket projectors. These products are in the market from manufacturers including Mitsubishi Electric, Samsung Electronics and Toshiba, TI noted.

More Flexible Display Products - TELECOM ITALIA will co-develop with **Polymer Vision** to build a ***rollable display*** enabled personal device for digital content distribution. The agreement will see the leading operator of the Italian mobile industry and the pioneers of the rollable display industry join to develop and launch the world's first rollable display enabled mobile device to market in 2007. The innovative terminal uses the unique Polymer Vision rollable display technology which enables mobile devices to incorporate a display larger than the handset itself and offers readability similar to printed paper. While smaller than a typical mobile phone, the new device features a display which extends up to 5-inches and may simply be stored away after use by folding it, thanks to the flexibility of the polymer based display material. The device features the largest display available in the industry for the same form factor, the 16 grey levels combined with a high contrast and high reflectivity display for paper like reading experience enables comfortable reading, even in bright sunlight. Future developments include color and moving image capable display. The rollable display enables reading entire newspapers as well as books that can be delivered and bought through mobile networks via a regular SIM Card within the device - and then stored in the terminal's memory which will be extremely large (starting from 4 Gigabytes available in the first models). The device will permit instant access to personalized data, e-mail, news, information feeds and location sensitive maps wherever and whenever. The always-on user experience is made possible through an optimized combination of cellular (EDGE/UMTS) and broadcast (DVB-H IP data-casting) mobile functionalities as well as a mini-USB slot for PC and wired/wireless broadband data connection. Together with superior text and graphic content, the new device will also download and play music, audiobooks and audio podcasts. Featuring single-handed navigation and control via an innovative touch sensitive LED user interface, as well as intuitively simple software, users will enjoy a new unique experience in managing, accessing relevant and

personalized high value content. With the extremely low power consumption of the display, the new device will deliver an exceptional 10 days of average usage time between battery charges.

Medical Tablet with E-Ink Display - Motion Computing and Intel announced their C5 medical tablet with some great features but the $2999 price tag may render it a non-starter. Another medical tablet from **Emano Tec** has emerged; the MedTab, 5.5" x 7.5", weighs 1lb, has a 12hr battery, and uses an E-ink display. E-ink is a black and white display technology that is extremely low power and requires no backlight. Like the C5 it's washable, offers Bluetooth and WIFI connectivity and is drop proof (probably even more so than the C5, since it doesn't have a hard drive). However, the price is still sky high, $4,995 for orders under 50 units and $1,999 for orders over 50.



Motion Computing: