SID 2002 REVIEW AND TECHNOLOGY ASSESSMENT

Information DISPLAY

September 2002
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SID

Official Monthly Publication of the Society for Information Display

- ***SID 2002 Review***
  - ***Show Overview*** • ***LCDs***
  - ***Emissives*** • ***Microdisplays***
  - ***Equipment and Materials***
  - ***Display Electronics***
- ***Coverage of PC Expo***

Four Honored with Academy's Awards for CELCO Digital Film Recorder:

Thank Committee and film star/host Charlize Theron for awards …*and kisses.*

March 2nd, Beverly Hills, CA

The Academy of Motion Picture Arts and Sciences (AMPAS) presented four awards "for scientific and technical achievement" to the developers of the CELCO Digital Film Recorder. Paul Constantine, brother John Constantine, Jr., cousin Peter Constantine and Carl Ludwig were honored during the black-tie gala event at the Regent Beverly Wilshire Hotel Ballroom on March 2nd, 2002.

CELCO film recorders "*have proved their exceptional merit through successful use*", according to Awards Administration Director, Richard Miller.

All Photos courtesy AMPAS and Long Photography, 2002.

Scientific and Engineering Plaque above awarded to CELCO Film Recorder developers Paul Constantine and cousin Peter Constantine.

Technical Achievement Certificates *were presented to John Constantine, Jr., and former CELCO employee and friend, Carl Ludwig. Charlize Theron at left with awardees. All photos courtesy AMPAS and Long Photography, Copyright 2002.*

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Information DISPLAY

SEPTEMBER 2002
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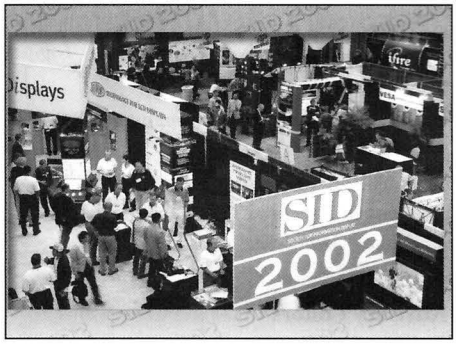
The explosion of OLED prototypes were hard to ignore at SID 2002, but that was not the only revolution-in-progress to be found in Boston. This issue presents full coverage of SID 2002 and the state of display technology.



Jeff Page for SID

Next Month in *Information Display*

Large-Area-Display Issue
- GigaSTaR Interfacing
- Can PDPs Compete?
- F!T Tube Technology
- Computex Taipei 2002 Review

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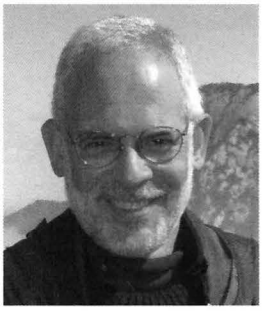

Hunting for Displays at PC Expo

PC Expo, held this year June 25–27 at New York's Jacob Javits Convention Center, is a smaller East Coast version of Comdex, and it has been getting smaller over the 3 years I have been going to it. The show's organizer, CMP Media, says the attendance this year was 35,000 (down from 45,000 last year) and the number of exhibitors was 350 (down from 400).

It is still a sizeable show, with an emphasis on IT issues such as disc backup systems, tablet PCs, keeping your PDA connected to your office LAN, and convincing customers that the recordable DVD industry really is ready to settle down to a common format (it is, except for Sony and Philips – which means it isn't) and that it is safe to start committing to a serious roll-out of the technology (your money, your choice). Clearly, Sony learned a different lesson from the Beta videotape fiasco than did the rest of the world, as indicated not only by its wanting to go its own way with recordable DVD, but by its manic promotion of Memory Sticks™, which were also much in evidence at PC Expo.

All this was interesting enough, but when it came to the editorial focus of this magazine – displays and, to a lesser extent, the input and output devices used in conjunction with displays – I was hard-pressed to fill a full day, something that was not the case 2 years ago. Still, there were some interesting things to see and talk about.

Ian Miller and the team from ***Samsung*** were showing off their wares in one of the many jury-rigged second-floor rooms that PC Expo rents to exhibitors for entertaining press, analysts, and serious customers. One interesting product was a 17-in. "Magic Bright" flat-screen CRT monitor that allows the user to select from three levels of luminance (for text, Web, and video) with a "hot key" button on the front of the monitor. This is entertaining, in part because you can easily see the image definition degrade with increasing luminance. The maximum luminance, said Miller, is 320 nits. This higher level of luminance comes with no decrease in life expectancy, says a Samsung press release. Increasing the maximum luminance without sacrificing lifetime was not trivial, said Miller, and required a package of design changes in both the CRT and the supporting electronics. There are two versions of the monitor: 185 MHz for a maximum resolution of 1600 × 1200 at 68 Hz ($229 MSRP) and 110 MHz for 1280 × 1024 at 65 Hz ($189 MSRP).

Samsung's ML-1430 laser printer for $199 was impressive. This faster replacement for last year's ML-1210 is rated at 15 copies per minute and produces 600 dpi. The duty cycle is 15,000 copies per month. Its low price includes built-in parallel and USB ports and Samsung's N–up printing mode, which lets the user display up to 16 pages of text on a single sheet.

The company also showed a nicely designed, bright 15-in. LCD monitor ($549 MSRP) which adjusts for height and tilt and folds flat. This can be convenient for the user, but it also provides the manufacturer with more economical shipping, said Miller, because many more monitors fit into a container. The speakers are enclosed in the base.

Also occupying the room were the wide-format 24-in. LCD that was "pre-released" at the Consumer Electronics Show (CES) in January and the 50-in. PDP (1366 × 768) for public-information and advertising applications. The

continued on page 60

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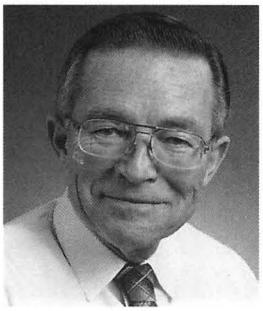

Choices Are Good . . .

by Aris Silzars

Most of us thrive on the excitement of exploring, the stimulation of being surprised, and the freedom to make our own choices. Without some ambiguity and uncertainty, our lives can become boring and stale. Is this a leftover remnant from the survival-driven origins of our species? I think not. It has indeed been with us since our cave-man days, but it is not a transient phenomenon to be solved by technology or by ever more abundant earthly comforts. The very nature of human existence has the built-in uncertainty of a mostly unpredictable ending point. Thus, it behooves us to have as many interesting experiences as we can during our current visit to this planet Earth.

What got me into this philosophical mood was a seemingly trivial event during a visit to the local outlet of a large office-supply chain. As I was paying for my replacement toner cartridge, the clerk asked me to provide some personal information that had nothing to do with this purchase. I politely declined – and promptly noted that, as I was leaving the store, my emotional temperature was rapidly rising into the danger zone. To put it bluntly, I was boiling mad! I just wanted to buy my toner cartridge, pay for it, and come home. Why do I need to be "profiled" while I am making a simple purchase? Of course the store's explanation is so that they can better provide for what their customers may want. However, now our local grocery store chain has introduced "advantage cards" for mostly the same reason. And the local electronics store wants to know my personal information so they can send me the "best promotional materials." And when I visit a Web site, my search habits are recorded so that I can receive specially selected e-mail spam. Is it possible that we may be reaching a saturation point in all this probing to establish our behaviors?

As for me, I have a strong message for all you merchants out there! You will find that I am far too unpredictable to be "profiled." Yes, I have some basic needs for food, clothing, and shelter. But beyond that, you have no idea what I will do next, or where I will go next. Most of the time, even I don't know. So please let me do my own searching and my own selecting. Let me make my own choices and sometimes even mistakes. For us human beings, browsing is good. An unstructured hour of page turning through the Sunday paper is good. An exploratory walk down a new city street is good. A visit to a newly discovered botanical garden is good. Having the unplanned experience of learning how to repair your overheating boat while out on a lake is also good – although maybe not as pleasant. Being told what we should like was *not* good when we were children and it is *still* not good.

These attempts by merchants and manufacturers to find the most successful products are really not all that harmful as long as vigorous competition and plentiful choices continue to exist. But if one merchant, manufacturer, or technology becomes too dominant, then we lose our ability to explore and find those unexpected, and often pleasantly surprising, benefits that a new and innovative product can provide. Sometimes it takes someone who, by most people's standards, is considered almost in the near-crackpot category to bring these new concepts into view. The first introduction of these ideas may not even be a commercial success, but the attempt may stimulate others with a more conventional, and

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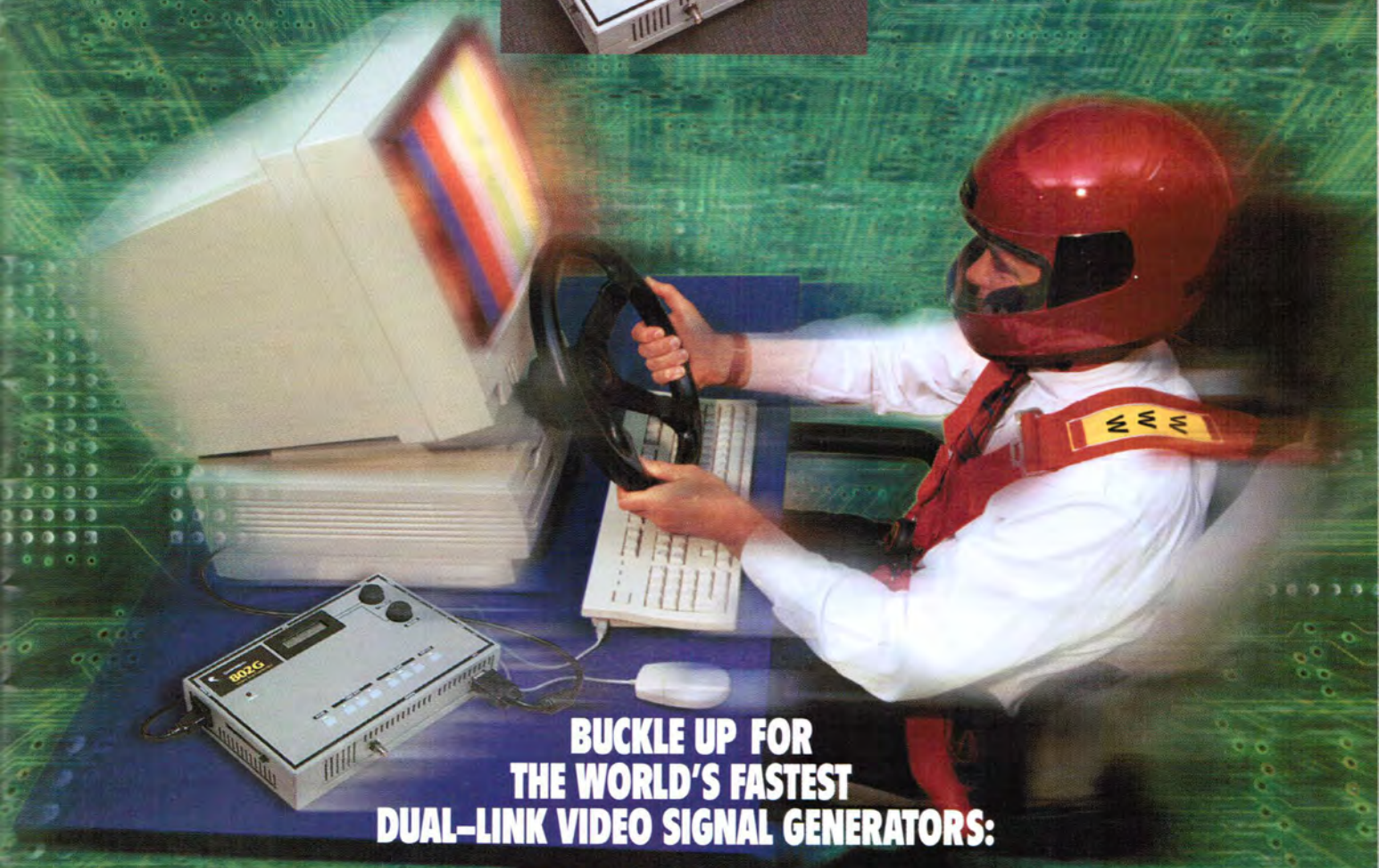

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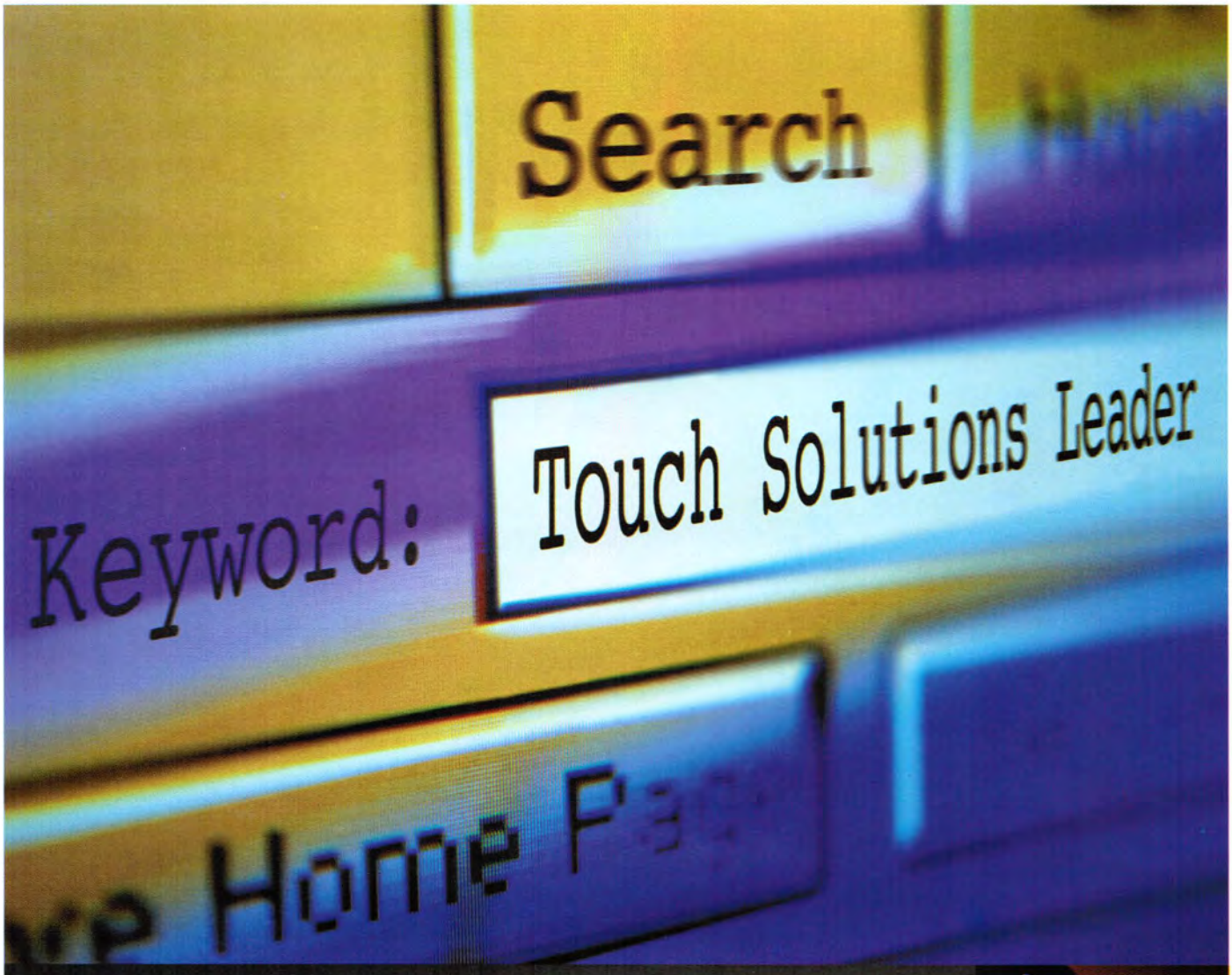

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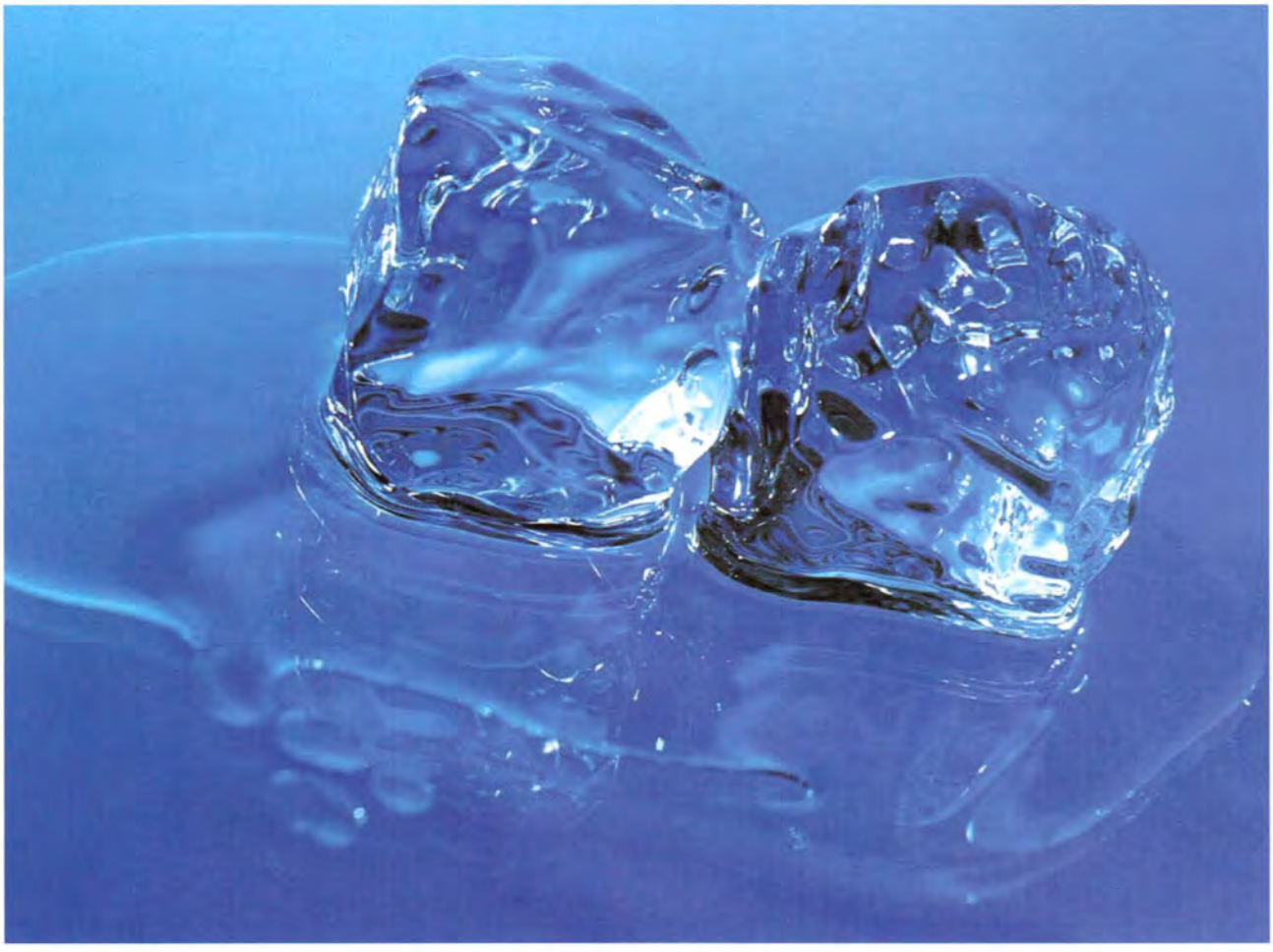

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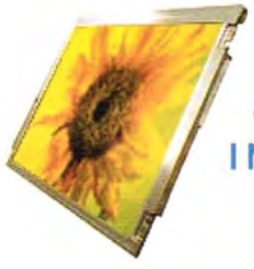

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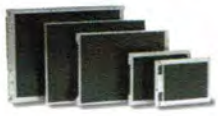

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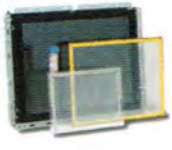

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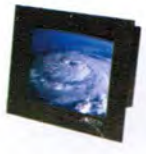

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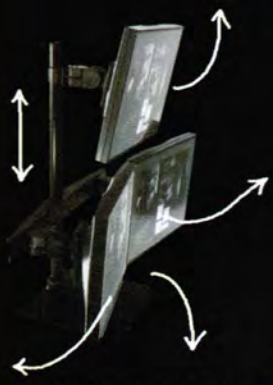

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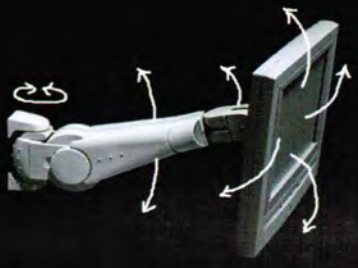

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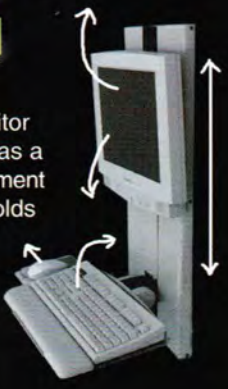

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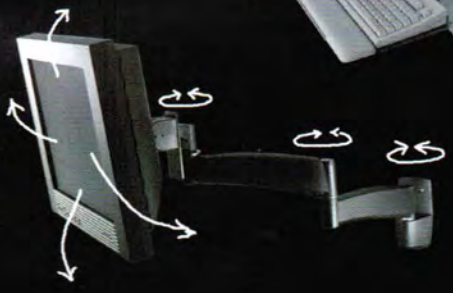

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OLEDs, OLEDs, Everywhere . . .

It was impossible to ignore the profusion of OLED prototypes at SID 2002, but they were not the only technology providing the heat that kept the show on the boil.

by Ken Werner

ORGANIC LIGHT-EMITTING DIODES (OLEDs) provided the obvious heat at the Society for Information Display's International Symposium, Seminar & Exhibition (SID 2002), held May 19–24 at Boston's Hynes Convention Center. A record number of technical papers – approximately 320 – were presented at this first SID Symposium to be held on the East Coast in 5 years. Although this was the only record breaker, the event typically received high marks from the exhibitors, speakers, and registrants queried by *Information Display*.

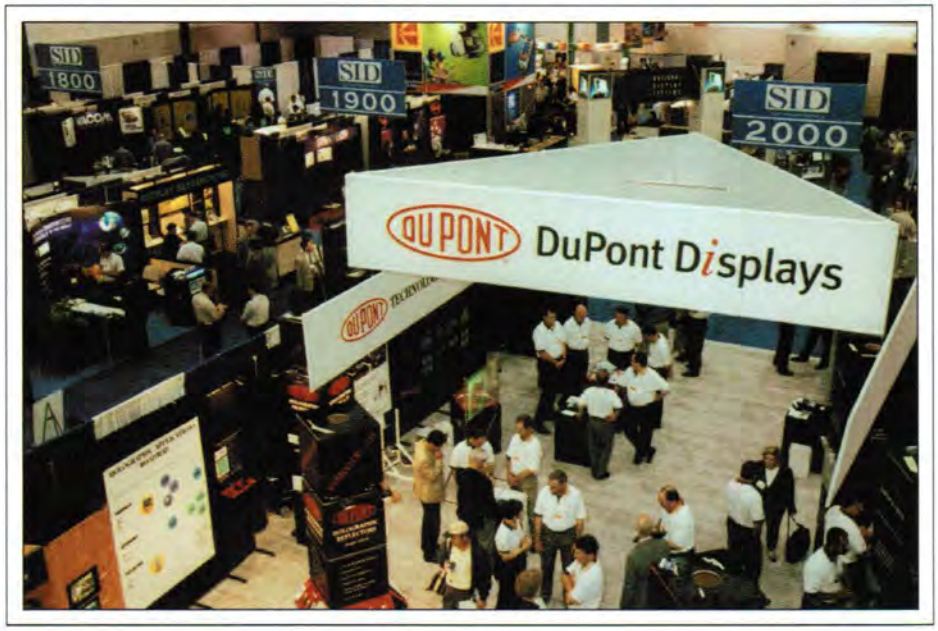
Most exhibitors said that although the reduced number of show attendees was noticeable, the average quality of contacts was considerably higher and business was good. Several exhibitors commented on an ongoing transition in the SID show that was, apparently, particularly noticeable this year. "This used to be a technology show," said one approvingly, "but it is increasingly a product and customer show. Business is being done."

The overall attendance was approximately 6500, said Mark Goldfarb of Palisades Convention Management, Inc., the firm that manages the SID symposia, compared to 7500 last year. Last year's attendance was a record, and represented an approximate 20% increase over 2000.) The number of exhibitors this year was 260 (compared to 280 in 2001) and the number of booths was 474 (compared to 524 in 2001), Goldfarb said. Paid registration for the technical symposium was 1660 (compared to 1802 in 2001), 750 for the Monday/ Friday seminars (compared to 792), and 436 for the Applications Tutorials (compared to 455).

There was one other record high number associated with SID 2002. The press corps covering the event reached 100 people – not counting analysts, who belong to a different species.

Year of the OLED Exhibitor

This may not yet have been the "year of the OLED," but it was clearly the year for OLED exhibitors. ***DuPont***, ***Kodak***, ***RiTdisplay Corp.***, ***Optrex***, ***Sony***, ***Cambridge Display Technology***, ***Universal Display Corp.***, ***Philips Components***, ***eMagin Corp.***, ***Opsys***, ***Neoview/ Sunic System***, and ***Toshiba–Matsushita Display***, among others, were very visible on the show floor. ***Dow Advanced Electronic Materials*** was making appointments with journalists to deliver the message that Dow "is poised to become the premier manufacturer of PLED materials." (Poised, perhaps, but not there yet. Dow, a CDT licensee,



Jeff Page for SID

A significant portion of DuPont Displays' large booth was devoted to OLEDs.

Ken Werner *is the editor of* Information Display.

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is currently building a plant in Midland, Michigan, said Dow's Dave Kyle.)

Also fishing for journalists and opinion makers off the show floor was the British-based technology-licensing firm ***BTG***. BTG provided a several-person-strong entourage for Arthur J. Epstein, Director of Ohio State University's Center for Materials Research. Epstein's team has developed an OLED-enhancing technology called symmetrically configured ac light emitting (SCALE). As BTG and Epstein explain it, current OLEDs are dc devices, their structures are asymmetrical, and they enjoy efficient charge injection only in one current direction (forward bias). SCALE technology introduces a redox (able to accept both electrons and holes) "encapsulating material" between each electrode and the organic emitting layer of the OLED. A SCALE OLED pixel can produce two colors of light – one for each current direction – and is said to offer improved lifetime and stability and to be compatible with roll-to-roll processing. Epstein said that the technology works with both small-molecule and polymer active layers.

Some technologies make it to successful production, some do not. So it is always comforting to see display technology on the show floor that is actually producing images. Particularly striking was the refined, very-thin version of ***Sony***'s 13-in. 800 × 600 OLED display. Impressive last year, the display is spectacular this year, with rich saturated colors. And for the first time, Sony is talking about production plans (for 2003). Toshiba–Matsushita Display showed its new 17-in. 1280 × 768 OLED, decisively taking the "mine is bigger than yours" title from Sony. But the development of the 17-in. is still in progress.

Also impressive was ***Kodak***'s AM550L, a 2.16-in. 521 × 218 full-color OLED display for portable entertainment and other applications. The 8-gram 120-nit display was showing rich saturated colors. Kodak's Les Polgar said that developer kits had just been introduced and are now available. Production will ramp up late this year at the Gifu plant of SK Display, the manufacturing joint venture established by Kodak and Sanyo. The full-color video-capable AM550L contrasted favorably to the many monochrome alphanumeric OLEDs seen around the show floor. In answer to a question from John Larish at a Tuesday morning press conference, Polgar said that the first Kodak camera with an OLED display will probably appear early next year.

Philips showed a polymer OLED protected from the environment by a developmental thin-film passivation layer, which permits a much thinner display than present techniques.

Jeff Page for SID

Display electronics and semiconductors in great variety have become an important part of the SID show. Here, a flex circuit receives an in-booth inspection.

LCDs: What Have They Done Lately?

If the talk and press coverage seemed to center on OLEDs, it is likely that part of the reason is that good-looking, durable, and economic AMLCDs for notebook computers and monitors have become commonplace. The wide variety of panels from leading manufacturers such as ***Samsung***, ***LG.Philips LCD***, ***NEC***, ***Sharp***, and ***Toshiba*** generally looked beautiful. Luminance, viewing angle, number of pixels, and panel diagonal are tailored to different applications in a dizzying number of combinations, with diagonals and number of pixels getting larger and an increasing number of wide panels in evidence. Larger panels are appearing in notebooks, with 15 in. becoming common, but pixel formats generally top out at XGA or SXGA+ for mainstream computers.

A major reason for this, said senior executives from two AMLCD suppliers, is Microsoft. The lack of convenient scaling of elements such as icons, tool bars, and menus scares many users away from displays with resolutions of UXGA and higher. Although Microsoft has given this problem short shrift in the past, the software giant is now starting to pay attention, said one LCD executive. But Windows feature sets are already locked in until 2005, said the executive, so there is no short-term relief in sight – at least not from Microsoft. But ***Portrait Displays***, the creators of the widely used Pivot® software for using displays in both landscape and portrait modes, was introducing LiquidView™ 2.0, which was to be formally released on June 18. This is the scaling software for Windows® that Microsoft left out. The new version offers enhanced flexibility and a very graceful user interface compared to Version 1.0, which sold 500,000 copies since Q4 '01. Portrait Displays was promising the announcement of major PC customers shortly.

Where Did Plasma Overcapacity Go?

A very interesting thing has happened to PDPs. In the four-month period starting (approximately) last November, the major Japanese PDP manufacturers have gone from having huge amounts of excessive manufacturing capacity to not having enough, according to spokespersons from ***NEC*** and ***Panasonic***. What happened? The major

Jeff Page for SID

Good-looking AMLCDs for monitors and laptop PCs were ubiquitous at SID 2002. These are from LG.Philips LCD, which announced its standing (in the sign at top left) as the world's leading supplier of 15-in. LCDs for notebook PCs.

Japanese consumer-electronics companies decided that PDP prices had gotten low enough to make PDP television sets affordable in the Japanese market. Currently, said NEC's Omid Milani, NEC's PDP allocation is roughly 90% to Japan for TV applications and 10% to the U.S. for information-display applications. With large volumes now flowing through the plants, more rapid price reductions are possible. And at least some of the major PDP companies are building new plants.

On the PDP-technology front, most of what was seen at SID was evolutionary. The exception was ***Plasmaco/Panasonic***, which showed a 60-in. prototype with 1080 lines, progressive scan, addressed from one edge of the panel only (single scan). Applying dual scan to this technology, said Plasmaco's Jim Noecker, would allow them to produce a 2000-line PDP, a format that would be directly compatible with digital-cinema formats.

New and Interesting

What else was new at SID 2002? Lots, and much of it will be covered in the following pages by the six correspondents *ID* unleashed in Boston: Stephen P. Atwood, Pat Dunn, Joe Hallett, David Lieberman, Alfred Poor, and myself. We also have expert opinions from CDT's Stewart Hough and Samsung Electronics's Jun Hyung Souk. Here are a few things that may not have been covered by my colleagues, or that I feel deserve highlighting in the context of this overview, as well as in the articles devoted to individual technologies.

Iridigm Display Corp. has been discretely developing its innovative MEMS iMOD (interferometric modulator) display technology for years, but went into serious promotional mode by formally introducing prototypes at SID 2002 and distributing a glossy full-color pamphlet. An iMOD element consists of two metallic electrodes separated by air. The one closest to the viewer is a thin-film stack on glass; the other is a flexible metal foil. In the OFF state, the cell gap is such that light reflecting from the front and rear electrodes interferes constructively and light is reflected. When a relatively small voltage is applied, the rear electrode is drawn toward the glass front plate, the interference is negative, and the pixel turns black. If an appropriate constant bias voltage is applied, the display can be made bistable. By carefully adjusting the cell gap in the OFF state, subpixels can be tailored to interferometrically produce red, green, or blue. Subpixels can be 25–60 μm on a side (400–1000 dpi), so producing gray levels by area dithering is

Jeff Page for SID

The staff in E-Ink's booth was proud of their thin reflective color active-matrix micro-encapsulated electrophoretic display, but some observers were more impressed with the very high contrast and matte surface of the passive bistable black-and-white version.

straightforward. Examples of color displays in PDA mock-ups shown at SID were sharp and quite bright. Colors were only moderately saturated, but were competitive with many of the LCDs used in such applications. This new reflective display technology does not absorb light in polarizers or color filters, so it should have high reflectivity. And it would appear that power consumption can be very low. Optical response time was not published. In the weeks following the show, Iridigm announced it had received $8 million in additional funding, to close its Series A funding round with $21 million. Now I know where the glossy pamphlets came from.

ClairVoyante Laboratories has been developing their PenTile™ Matrix pixel geometry and 2-D subpixel-rendering approach for some time (see *Information Display*, Dec. 1999). At SID 2002, the company unveiled the first prototypes with development partner Samsung Electronics. By adjusting subpixel geometry and/or arrangement so that subpixel rendering is possible in two dimensions, and taking advantage of the fact that there is more blue information provided in a standard pixel arrangement than the human visual system can use, the PenTile™ approach allows a mananufacturer to produce displays with substantially greater effective resolution without increasing the number of drivers or TFTs in the display. (Alternatively, the manufacturer can opt to keep the effective resolution the same and reduce the number of drivers and TFTs.) Commercial products are expected, perhaps within the next year. (I certainly believe in the accuracy of these comments. Nonetheless, as you evaluate them, you should know that I am a member of ClairVoyante's Advisory Board.)

Philips Components showed the thinnest-ever (at 3.5 mm) 3.5-in.-diagonal QVGA LCD. The display embodies several technological advances, and also incorporates a very narrow non-active area. The folks at Philips are clearly very proud of this device. They are also working on transducers to make the display surface into a loudspeaker.

Amulet's Easy GUI® ASIC controller chip combines an LCD controller and a user-interface engine that makes it easy to design graphical user interfaces for embedded control applications without the coding in C++ or another language. Amulet's chip and compiler allows the interface to be constructed with a graphics program (such as Paintshop Pro) for constructing images and Web-page authoring tools to create the desired look and feel. The Amulet compiler is then used to compile the HTML from the Web authoring tools into μHTML, which is then used to program the flash memory. A control interface can be created in a few hours instead of days or weeks, says Amulet.

Amulet's clever user-friendly approach, Philips's work on incorporating more of the system onto the display, and Portrait Display's LiquidView™ all indicate the growing importance to display buyers of components that have not traditionally been part of the display. Ease of integration and fast time to market are critical, and buyers want help from their display and component suppliers. The "smart display" movement is certainly part of this, and so is the increasing presence at SID shows of display-semiconductor and board-level-electronics and single-board-computer makers.

For the first time, this SID Review Issue will contain an article devoted entirely to the display semiconductors and display electronics shown at SID. But the segment is already so large that full coverage in a short review article is not feasible. ■

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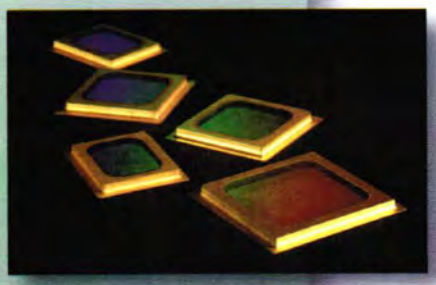

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LCDs: The 800-pound Gorilla

Except for television, LCDs now represent the world's dominant display technology, and they are produced in many variations designed to satisfy an astounding array of applications.

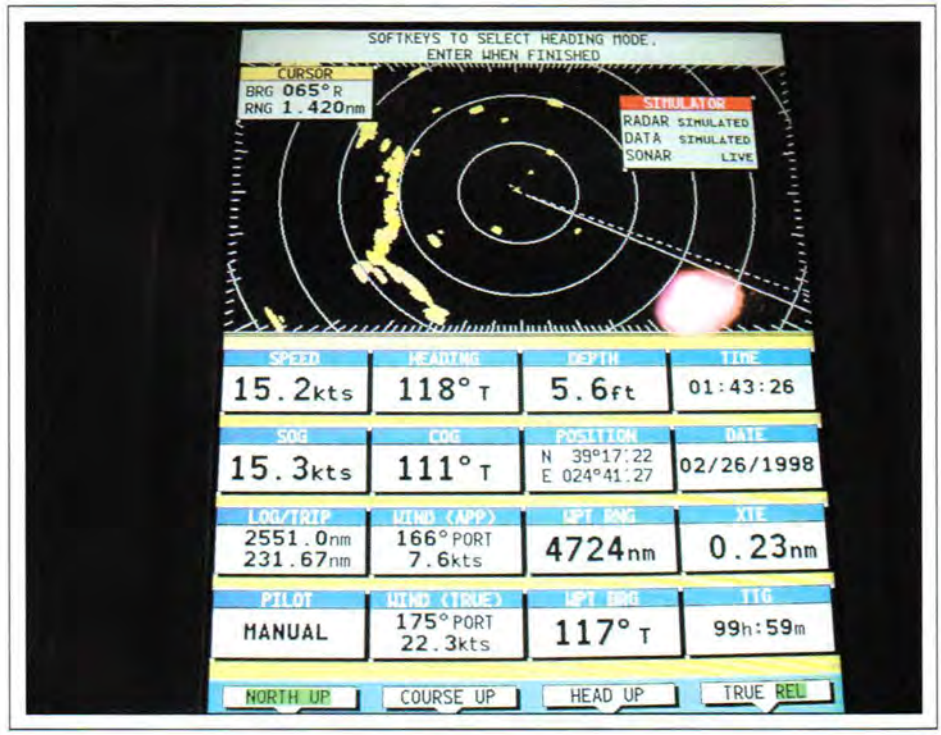
by Alfred Poor

THIS is a watershed year for direct-view LCD technology, according to iSupply/Stanford Resources; it is the first year in which revenues for desktop-computer LCD monitors will surpass revenues for CRT monitors, at about $15 billion. Yet, while all active-matrix LCD (AMLCD) panels larger than 9 in. on the diagonal will account for 65% of the LCD market revenues this year, 92% of the LCD units to be shipped in 2002 will be passive-matrix supertwisted-nematic panels.

Clearly, the LCD market is complex and changing rapidly, but the theme that runs throughout is "growth." And nowhere was this demonstrated better than by the range of products and prototypes on display at the 2002 SID exhibition. From new technology to new products for familiar applications, from revolutionary to evolutionary advances, manufacturers are moving the LCD market forward on many fronts at once. As Bruce Berkoff, Marketing Executive V.P. at LG.Philips LCD put it, the industry goal is simple: "more glass per person."

New Technology

The products that get the lion's share of the attention at a show like this are the ones that demonstrate something quite different from existing products. One of the demonstrations that falls into the novel category is the PenTile™ technology from ***ClairVoyante Labs*** (Sebastopol, California, www.clairvoyante.com). This is a new way of configuring the red, green, and blue cells in order to create effectively higher-resolution displays using the same number of LCD cells. In partnership with ***Samsung***, ClairVoyante has produced sample panels using their PenTile™ 1 pattern, which were on display. The algorithms for converting an image signal for this new subpixel configuration were programmed into a field-programmable gate array (FPGA), but the company has plans to integrate these functions in other panel application-specific integrated circuits (ASICs) as they move into the commercialization phase. Consumer-TV



Ken Werner

Global Display Solutions showed this industrial TFT-LCD in an award-winning marine console made by customer Raymarine.

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Ken Werner

This Sharp 15-in. UXGA TFT-LCD, which has a compact form factor, produces a luminance of 180 nits, is advertised as low power, and uses Sharp's ASV technology, is intended for laptop-PC applications.

products using PenTile™ technology could be available in early 2003, with portable-notebook screens becoming available in late 2003.

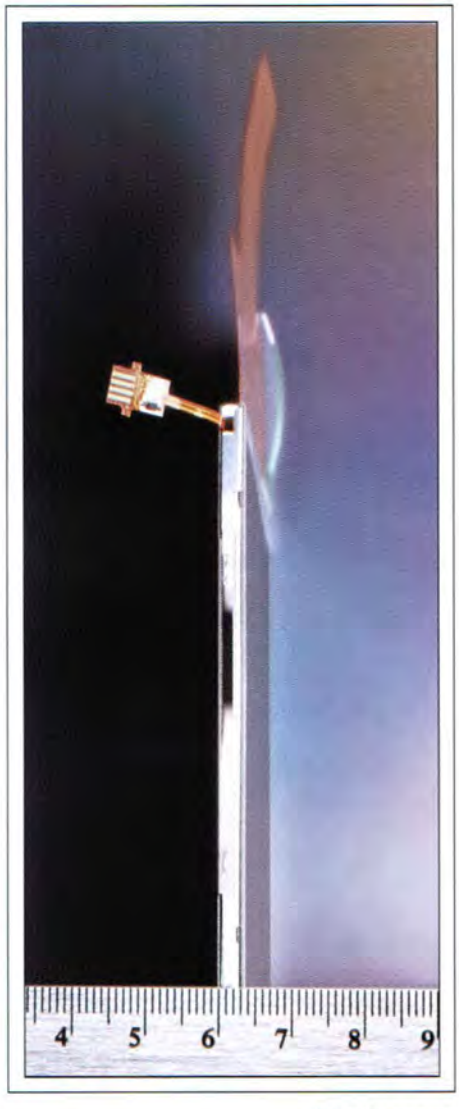
Another new technology being pursued by many companies is the creation of LCD panels on plastic substrates. One novel approach was demonstrated by ***Viztec*** (Cleveland, OH, www.viztec.com). A mixture of polymer and liquid-crystal materials is placed between two substrates, and ultraviolet (UV) light is used to harden the polymer material. It creates vertical columns between the two substrates, and the liquid-crystal material separates into separate cells. Viztec is working with FlexICs, which specializes in very-low-temperature polysilicon-on-plastic substrates, and with Promerus, which makes optical-grade plastic films.

Closely related are the various forms of bistable LCDs that were on exhibit. These panels are of particular interest to designers of battery powered mobile devices because once the image is drawn on the display no additional power is required. One of the most interesting was from ***Nemoptic*** (Magny les Hameaux, France, www.nemoptic.com), which uses standard LCD material to create bistable panels. The standard material can be made bistable by the use a weak anchoring system on one of the panel substrates. The company demonstrated a 6-in. VGA panel that had excellent contrast.

Kent Displays, Inc. (Kent, Ohio, www.kentdisplays.com) showed improved versions of its cholesteric-LCD (Ch-LCD) displays, with cell-response performance that is twice as fast as that of previous panels. The front-lit reflective version is ready for production; the backlit version will be ready soon.

Display Research, Inc. (DRI) (Wylie, Texas, www.displayresearchinc.com) also had Ch-LCD panels, which the company claims are designed in a way that does not infringe on the intellectual property of Kent or other companies. Their black-and-white panel works by reflecting UV or IR light, not visible light.

And while it is not LCD technology, we will mention that ***E-Ink Corp.*** (Cambridge, Massachusetts, www.eink.com) and its partner ***Philips Components*** (Sunnyvale, California, www.components.philips.com) were showing various forms of E-Ink's bistable displays that are based on microcapsules filled with black-and-white pigmented electrophoretic particles. The panels had impressive contrast, and the viewing angle was so wide that the panels almost looked as if they had emissive screens. The company currently uses batch processing for panel fabrication, but they are working with Toppan to develop roll-to-roll production. E-Ink has passive-matrix direct-drive designs for low-density information applications such as transporta-



Philips Components

Philips Components was clearly proud of its newly introduced 3.5-in. QVGA TFT-LCD that is only 3.5 mm thick – the thinnest such display yet made.

Optrex America

Optrex fabricates its "Mechatronics" LCDs so that LCD alphanumerics and icons can be presented under a mechanical pointer, which automobile buyers (and manufacturers) prefer.

tion signage, but it also showed a 5-in. color panel using active-matrix TFTs; Philips should be shipping a monochrome version by the summer of 2003. E-Ink has also been working with metal-foil backplanes to create flexible displays.

Another new technology that was on display is three-dimensional screens. ***Samsung SDI*** (Korea, www.samsungsdi.com) and the ***DDD Group*** (Santa Monica, California, www.ddd.com) had autostereoscopic LCD panels using lenticular screens. ***Deep Video Imaging*** (Hamilton, New Zealand, www.actualdepth.com) had a novel approach, using an LCD panel overlaid on top of another. As a result, one can look through the top image to see the back layer. This gives an indication of depth, but, more importantly, allows designers to layer information on the screen, displaying more information at once than is possible with a single screen.

There was other new LCD technology on display as well. ***LG.Philips LCD*** showed a panel with copper bus lines that can transmit signals 2.5 times faster than traditional aluminum alloy. The end result is a display with higher brightness and resolution; the first production panels should ship by the end of 2002. LG.Philips LCD also showed a method of overdriving LCD cells – apparently similar to the Mitsubishi "feed-forward" technology – that speeds up pixel response time dramatically. This is needed for the next generation of LCD TVs. Many of the best of the current crop of LCD TVs still show slight smearing on moving images, and, in at least one major brand of LCD TVs, the smearing is more than slight. The kind of technology LG.Philips LCD showed will help produce the first generation of "no-apologies" LCD television sets.

Two other products were on display that are not LCD products, but could have interesting implications for some LCD devices.

Portrait Displays (Pleasanton, California, www.portrait.com) demonstrated version 2.0 of LiquidView™, which is software that makes it easier for Windows™ users to make fonts and icons larger. This could become increasingly important as the pixel-per-inch specifications rise on computer-monitor LCD panels.

And ***Philips Components*** showed a transducer that can be mounted on the back of a flat-panel display, turning the panel into a speaker. It worked surprisingly well – even on a handheld-sized panel – and was certainly better than most speakers that are built into LCD desktop monitors. Philips Components is working on a second-generation version that will be able to create stereo sound from a single display.

Non-PC Applications

The vast majority of the panels on exhibit were intended for applications other than PCs. Cellular phones, industrial and automotive instrumentation, and PDA displays were everywhere, but the big news was LCD televisions.

Leading the way were the large-format panels. Now that 5th- and 6th-generation LCD-fabrication plants are starting to come on line, manufacturers can make larger panels more efficiently. ***Samsung Semiconductor*** (San Jose, California, www.usa.samsungsemi.com) could claim the "boast for the most" prize with a 40-in. TFT-LCD panel. It has WXGA resolution (1280 × 768 pixels) with a 0.68-mm pixel pitch and patterned vertical alignment (PVA) for wide viewing angles, the panel weighs 12 kg. ***LG.Philips LCD*** was not far behind with their 30-in. WXGA panel at 6.4 kg, but this display has the added distinction of being in production and shipping now. ***Sharp Microelectronics of the Americas*** (Camas, Washington, www.sharpsma.com) also has a 30-in. WXGA LCD-TV panel that will ship in Q4 '02, and a 20-in. panel with wide-viewing-angle Advanced Super View (ASV) technology is now in production. The 2002 SID/*Information Display* Display of the Year Gold Award winner ***Rainbow Displays*** (Endicott, New York, www.rainbowdisplays.com) was also on hand with their 37.5-in. tiled LCD.

LCDs for mobile devices – everything from cellular phones to PDAs – also received a lot of attention. Sharp highlighted their progress in continuous-grain silicon (CGS) technology. The increased electron mobility compared with standard amorphous silicon makes active-matrix-TFT designs more power-efficient while increasing the cell aperture ratio. The drivers can be incorporated on the display substrate, which saves space, reduces assembly costs, and increases reliability. Sharp showed a 2-in. QVGA panel that is slated to go into production in October 2002, and also showed a 3.5-in. transflective QVGA panel.

Philips Components also had an extremely thin 3.5-in. QVGA TFT-LCD that was only 3.5 mm thick. The company is working on amorphous-silicon and LTPS designs for their panels.

Three-Five Systems (Tempe, Arizona, www.threefive.com) showed a 2.2-in. QCIF+ (176 × 220 pixels) TFT color panel that is aimed at applications using the QCIF video-conferencing standard.

There were many automotive LCD applications in evidence, but ***Optrex America***

LG.Philips LCD

Manufacturers seem to feel that TFT-LCDs in 30-in. WXGA format will be a popular size for TV and public-information applications. This one, by LG.Philips LCD (appearing in a Philips public-information display), is shipping now.

(Plymouth, Michigan, www.optrex.com) may have had the most. (One-third of the company's business is based on automotive applications.) Optrex has developed an STN technology called Trim Fine Crystal Color (TFCC) that uses active multiple-line addressing to improve the performance of the panels. The company has also developed "mechatronics" STN panels that have a hole in the middle so that a mechanical axle can extend through the panel and a pointer can be mounted in front of an LCD gauge display. The 2002 BMW 7-Series automobiles will include displays using this technology. Optrex also has TFT-LCD panels for use in automobiles; their 6.5- and 7.0-in. units are intended for "infotainment" applications for passengers, such as watching movies. The displays have a –30°C to +85°C operating range, making them well-suited for automotive use.

Another non-PC application is industrial use, where rugged high-brightness panels are essential for a successful display solution. Many companies were showing such panels, including ***Global Design Solutions***, ***Vertex-LCD***, ***Panelview***, ***i-SFT Industrial Siemens Flat Panel Technologies***, ***Kristel Custom Display***, ***IEE***, and ***Landmark***. ***NEC Electronics*** (Santa Clara, California, www.necel.com) also had a variety of LCD panels intended for non-PC applications, including a 10.4-in. transflective panel and an 8.4-in. VGA panel with a bright 450-cd/m^2 light output.

There were also companies that specialize in low- and high-density passive-matrix LCDs, including ***Emerging Display Technologies Corp***. (Irvine, California, www.edtc.com) and ***GPO LCD*** (Hsinchu, Taiwan, www.gpo.com.tw).

PC Applications

LCD panels remain an important part of the PC business. Margins on desktop monitors are currently razor thin, but the price structure of notebook computers makes it more appealing to supply LCD panels for these applications. There was little new in terms of the displays for these uses, but a Samsung representative said that the company expects to sell 31 million notebook displays this year, plus another 30–35 million desktop-monitor LCD panels, the majority of which will be 17-in. Most of these will use basic LCD technology. Premium panels such as those with wide-view PVA technology will be in much lower demand.

Planar (Beaverton, Oregon, www.planar.com) showed a number of PC desktop LCDs, as well as some designed specifically for medical applications.

Distributors

Not all exhibitors of LCD products at SID 2002 were manufacturers. Distributors play a key role in the distribution of panels, and can help designers find the panels that are best-suited for their applications. Some of the distributors exhibiting included ***National Display Systems*** (Morgan Hill, California, www.nationaldisplay.com) and ***JACO Electronics*** (Hauppauge, New York, www.jacodisplays.com). One distributor – ***Earth LCD*** (San Juan Capistrano, California, www.earthlcd.com) – has carved out a unique niche in the supply chain. They specialize in buying surplus and overstock panels from manufacturers and end-product producers and then selling them at a substantial discount. Among their offerings at the show were a 14.1-in. color computer monitor for $279 and a 12.1-in. color TV for $599.

Of the 260 exhibitors at SID 2002, a large number were related to LCD-panel production, either directly or indirectly. LCD-panel technology has matured to the point where many segments have reached commodity status, with multiple suppliers and relatively stable prices.

There is also plenty of innovation under way, however, and the evolution of some applications (such as the convergence between PDAs and cellular phones) as well as aggressive moves into new markets such as LCD TV present new challenges that may open the field to new players. And emerging consumer markets such as China may produce more rapid growth than is currently anticipated.

The bottom line is that direct-view LCDs are central to the display industry. As seen from the products on display this year, companies are working hard to take advantage of the technology's position. It looks like there is more glass – and perhaps plastic – in everyone's future. ■

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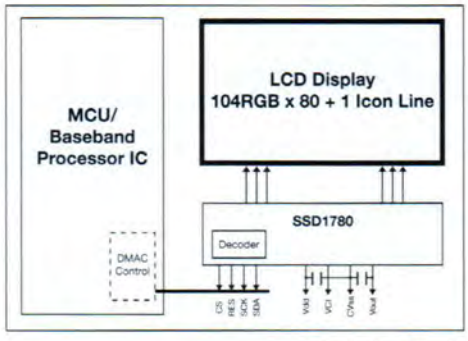

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Circle no. 13

Emissives Shine at SID 2002

A stroll across the SID 2002 exhibit floor showed PDPs getting bigger, OLEDs getting ready for prime time, and a few novel display technologies nibbling around the edges.

by David Lieberman

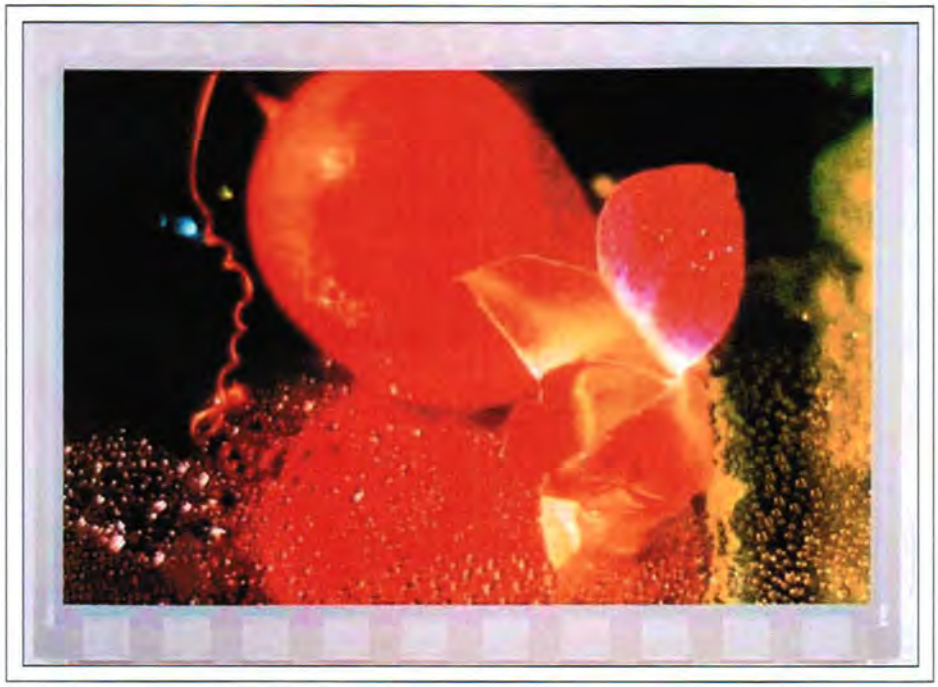
In most transmissive and reflective flat-panel-display (FPD) applications today, the liquid-crystal display (LCD) reigns supreme, but the future may present an entirely different picture. Already, emissive plasma-display panels (PDPs) have virtually captured the 40-in.-and-larger display arena, and emissive organic light-emitting-diode (OLED) displays are about to mount a serious challenge to LCDs in the small (approximately 2–5 in.) end of the market.

As at last year's SID symposium, SID 2002 was rife with emissive displays of many kinds, including OLEDs in great profusion, a healthy complement of PDPs, a few stray vacuum fluorescent (VF) and thin-film electroluminescent (TFEL) displays, an occasional cathode-ray tube (CRT) – for demonstration purposes only – and several developmental displays. This year, the developmental group included carbon-nanotube field-emission displays (CN-FEDs) from Noritake and the thick-film-dielectric (TFD) displays of iFire Technology, Inc.

At its booth, ***Noritake*** featured a new line of drop-in graphics replacements for alphanumeric VF modules. In addition to these monochrome (blue/green) display modules, it also demonstrated active-matrix VF modules capable of video and multicolor VF modules with combinations of red and either blue or green. The company is targeting its CN-FED work at large-pixel modules for stadium-type displays. The six-pixel module shown this year produced a nice bright red, blue, green, and white.

As for TFEL displays, ***Planar*** demonstrated a single miniature active-matrix electroluminescent (AMEL) display at a booth dedicated mainly to LCD monitors, and ***Lite Array, Inc.***, demonstrated an array of TFEL displays showing text and coarse graphics in various sizes and in 160 × 80-, 320 × 256-, and 480 × 240-pixel formats.

Lite Array is no longer using Luxell's dark-layer technology as a contrast enhancer, explained Vice President of Sales Geoff Lustig, but is developing its own. The technology in development should boost luminance from 110 to the 150 nits needed for out-



Toshiba

Toshiba's 1280 × 768 17.1-in. polymer-OLED prototype, fabricated by ink-jet printing, is now the world's largest OLED display.

David Lieberman *is a veteran display journalist living in Massachusetts. He is a contributing editor to* Information Display; *e-mail: davidlieberm@earthlink.net.*

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door applications, he explained. The company is also developing TFEL displays that solve the phosphor-burn-in tendency of existing TFEL displays, he added. A transparent 160 × 80-pixel TFEL display was also demonstrated.

For its part, ***iFire Technology, Inc.***, demonstrated the latest milestone in its technology quest with a 17-in. TV-display prototype. Like TFEL, the iFire technology uses thin-film phosphors, but it replaces TFEL's thin-film dielectric with a patented thick-film structure that it says enables both high performance and very low manufacturing cost. The prototype represents the technology's scale-up in size of "CRT-like color quality," according to Vice President of Business Development Joe Virginia, first demonstrated on a 2-in. display in January 2001 and then on an 8.5-in. display in June at SID 2001.

PDPs – Getting Bigger and Better

As at last year's SID exhibition, ***Plasmaco, Inc.*** – Matsushita's U.S. R&D subsidiary for plasma displays – featured two PDPs at its booth (but last year's 42-in. model was replaced by a 50-in. display), both of which are commercially available from Matsushita (Panasonic). Appearing for the third year in a row was a 60-in. wide-screen prototype PDP HDTV, but this year's version was different. The big panel had 1080 rows of pixels, enough for the highest-resolution HDTV mode, and, unlike most plasma panels, all of the pixels are addressed from only one horizontal edge of the panel instead of both edges. It is therefore said to use "single drive" instead of "dual drive." With dual drive, the Plasmaco technology is capable of making a 2000-line PDP, which would be compatible with digital-cinema formats. Despite the prototype status and advanced features of the 60-in. model, it nevertheless appeared ready (if certainly not priced) for prime time, with impressive brightness and excellent color saturation. It performed better on the show floor, in fact, than the 50-in. model sitting next to it, including its ability to reduce blur in moving images. Flatron PDPs figured prominently at ***LG.Philips***'s booth in sizes ranging from 37 to 60 in., and ***NEC Electronics, Inc.***, was showing a 61-in. model with an improved 700:1 contrast ratio. According to Omid Milani, NEC's PDP operations are "now at 96% of capacity" cranking out 42-in. models.

Pioneer Corp. brought a third generation of its 50-in. 1280 × 768 display to SID 2002, a unit that has a redesigned cell structure that the company's Laura Walsh said delivers deeper colors and crisper detail. The company's first Energy-Star-compliant PDP is cleverly configured with a slot for an optional add-in board to customize it for different markets. Walsh said that about a dozen third-party companies are supporting the concept with add-in boards for functions such as TV tuners, computer monitors, and video walls.

Philips Components

Philips's 1.4-in. passive-matrix monochrome polymer OLED.

Samsung Digital demonstrated 42-, 50-, and 63-in. PDPs at its booth, along with 43- and 50-in. digital-light-processing (DLP) rear-projection displays and its impressive 40-in. direct-view LCD. The 50-in. PDP, adjacent to the 40-in. LCD, appeared to show better detail, although the LCD was brighter and had better whites and blacks.

The Run to Organic

As at last year's SID exhibition, OLEDs were among the stars on the show floor, with repeat appearances of miniature – approximately 1 in. on the diagonal – OLED-on-silicon displays from ***eMagin Corp***. and the 13.1-in. prototype low-temperature polysilicon (LTPS) OLED that ***Sony Corp***. debuted at SID 2001, the largest OLED ever shown until that time. This year, ***Toshiba*** took the lead in OLED prototypes, demonstrating a 17.1-in. LTPS OLED to follow the 2.2-in. version it first showed at SID 2001.

The OLEDs at SID 2002, as at SID 2001, were almost universally very bright and very fast. Contrast, sharpness, color quality, and, where applicable, video capabilities varied considerably. There is as yet no clear trend to indicate which of the two main competing chemistries – small-molecule OLEDs or polymer OLEDs – will ultimately become the most popular, but manufacturing is on the uptick for both.

The OLED revolution started in the chemistry lab, and OLED materials vendors were well represented at the symposium. David Fyfe, President of polymer-OLED-pioneer

Ken Werner

Plasmaco's impressive 1080-line (progressive) single-scan 60-in. plasma display.

Cambridge Display Technology (CDT), reported that stability is on the rise for polymer OLEDs as well as the potential applications. "We are getting 5000 hours on our new blue material, twice what we had one year ago," he said. "That is within the specification for wireless devices."

But, said Johan van de Ven, Vice-President of Mobile Display Systems at ***Philips Components***, "their lifetime needs to get better" to move beyond such applications as mobile phones, "especially blue for polymer OLEDs and red for small-molecule OLEDs." In addition to its blinking OLED booth badges, CDT also demonstrated a handheld MP3 player with an OLED from its Delta licensee and a Motorola cellular phone with an OLED from CDT licensee OSRAM Sylvania. CDT licensees have reported "getting incredible yields at this early stage of development," said Fyfe. Consumers, he said, will be willing to pay 15–30% more for a product with an OLED because of OLED technology's demonstrable superiority over LCDs.

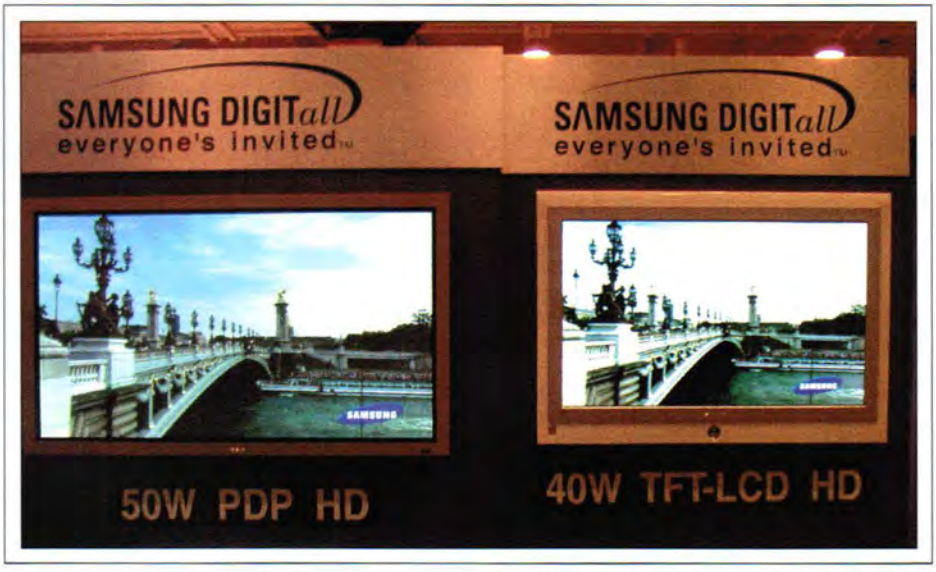
Covion Organic Semiconductors GmbH was showing small-monochrome OLEDs in orange, yellow, red, blue, and green; and ***Universal Display Corp. (UDC)*** demonstrated small matrices of single-color pixels as well as monochrome (green or blue) phosphorescent OLED displays in a 248 × 64-pixel format.

Samsung SDI demonstrated a phosphorescent OLED using Universal Display Corp. materials. This 2.2-in. 176 × 220-pixel multicolor LTPS OLED produces a peak luminance of more than 300 nits, compared to about 60 nits for a conventional LTPS polymer OLED that the company also showed, and its red and green phosphorescent materials have three times the efficiency of conventional electroluminescent (EL) materials, a company spokesman explained. And at 250 nits, the phosphorescent display dissipates only about 200 mW with 30% of its pixels on.

At the SID 2002 technical symposium, ***Opsys*** announced that it has achieved the highest efficiency yet reported – 40 lm/W at a 400-nit luminance level – for a solution-processed OLED. The company believes that this achievement brings its proprietary dendrimer OLED technology "closer to commercial viability for efficient low-cost manufacturing of flat-panel displays," as Opsys CEO Michael Holmes put it. "Dendrimers have the potential to make long-term improvements in color quality, power efficiency, lifetime, and processing costs of displays," he said. "These are vital for OLEDs to fulfil their potential for growth within the displays sector and to meet their transformational expectations in lighting, decor, and signage applications."

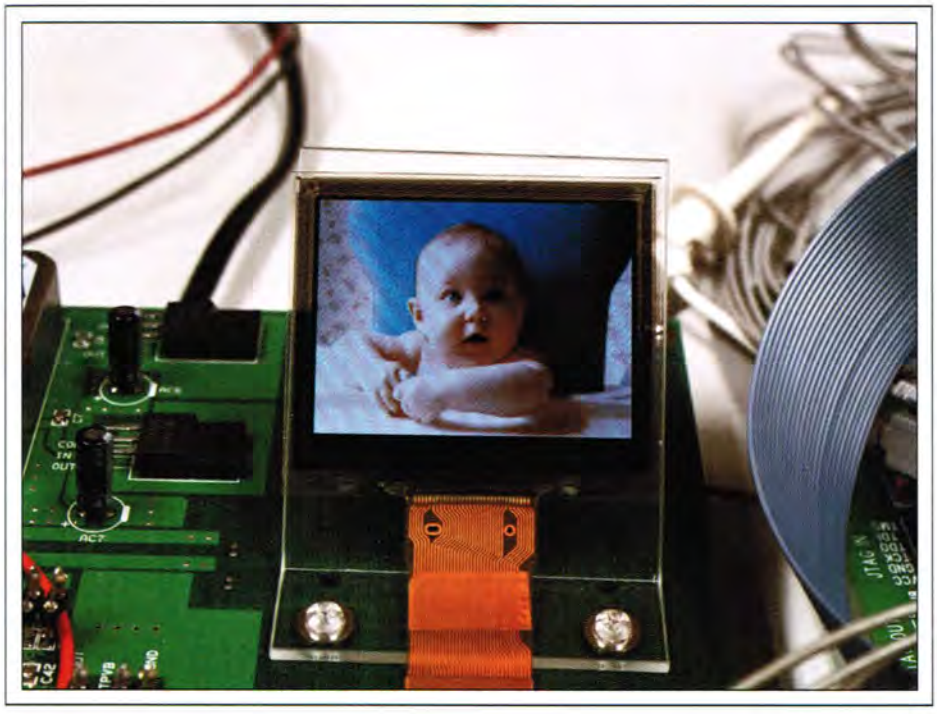
OLEDs Big and Small

Toshiba's 17.1-in. OLED prototype, which made its first public appearance in April in Japan, is a polymer-OLED device with a



Ken Werner

Samsung placed its 50-in. wide-format PDP next to its 40-in. wide-format AMLCD for a direct comparison. The PDP was sharper; the AMLCD was brighter.



Eastman Kodak Co.

At SID 2002, Kodak announced the availability of a design kit for its AM550L 2.16-in. LTPS active-matrix full-color OLED, which featured sharp images and rich saturated colors.

1280 × 768-pixel format, up to 300 nits of luminance, and a 256,000-color palette. It is clearly still a prototype, with some obvious flaws and artifacts, but it represents "an enormous achievement in a short amount of time," according to Fyfe.

The ***Sony*** LTPS OLED showed excellent color and contrast. A Sony spokesman said the company hopes to be selling this 300-nit (peak) 800 × 600 display in the fall of 2003.

In the near term, ***Toshiba*** also showed a 2.2-in. 176 × 220-pixel OLED which it first demonstrated at SID 2001. Mass production is planned for later this year. The little display was excellent, although it had some non-operational pixels. The Toshiba OLEDs are all patterned using ink-jet printing.

SID 2002 saw the first demonstration of a still smaller "see-through-capable" OLED-on-silicon display from ***eMagin Corp***. – a sub-1-in. monochrome (green) SVGA+ greater-than-1000-nit small-molecule OLED for industrial and medical applications that can make good use of screen overlays. It draws less than 300 mW.

The company also demonstrated its displays in end products and developmental products from partners. Among these were a thermal-imaging camera, a head-tracking system, and a 3-D "stereovision" headset. The camera and head tracker worked flawlessly; the 3-D is not yet prime. According to Olivier Prache, Vice-President of Microdisplay Product Development at eMagin Corp., next-generation gaming headsets will bring head tracking and 3-D together. By slightly tweaking its displays, he added, eMagin can now use an output from an nVidia graphics chip to provide alternating left- and right-eye views for 3-D.

Elsewhere, LCD specialist ***Optrex*** returned with an OLED prototype for automotive dashboards. The area-color display has green and red sections, with mass production expected in 2003. "It has broader color than VFDs," said the company's John Cramer. "The door is ajar."

In the middle ground between approximately 2 and 5 in., ***DuPont Displays*** and ***RiTdisplay Corp***. both showed off dozens of small OLEDs as they had the year before. DuPont is in the polymer-OLED camp, while RiTdisplay makes small-molecule OLEDs. As a DuPont manufacturing partner, though, RiTdisplay has plans to have polymer OLEDs in production in Q3 '03.

Asked whether OLEDs are, under real-world conditions, delivering their claimed power advantage over LCDs, a DuPont spokesman said, "that is still in the zone of acrimony. Power is still in the value proposition stage, but it should be marginally higher than that of a passive LCD."

In addition to its familiar slate of monochrome and so-called "area color" displays, DuPont demonstrated an AMOLED for the first time, a 4-in. QVGA prototype targeted at pocket PCs. Like Toshiba, DuPont uses ink-jet patterning. "We're studying the best way to configure the drive scheme," said the spokesman.

The many OLEDs shown at RiTdisplay's booth, all passive and small-molecule, ranged in size from 0.96 to 3.65 in. on the diagonal and approximately from 64 × 48 to 160 × 160 pixels in format. In many cases, sharpness and contrast were excellent; in other cases they were not. One eBook-oriented OLED had a nice touch: it displayed a vertical line in the middle of the display to represent the spine of a book.

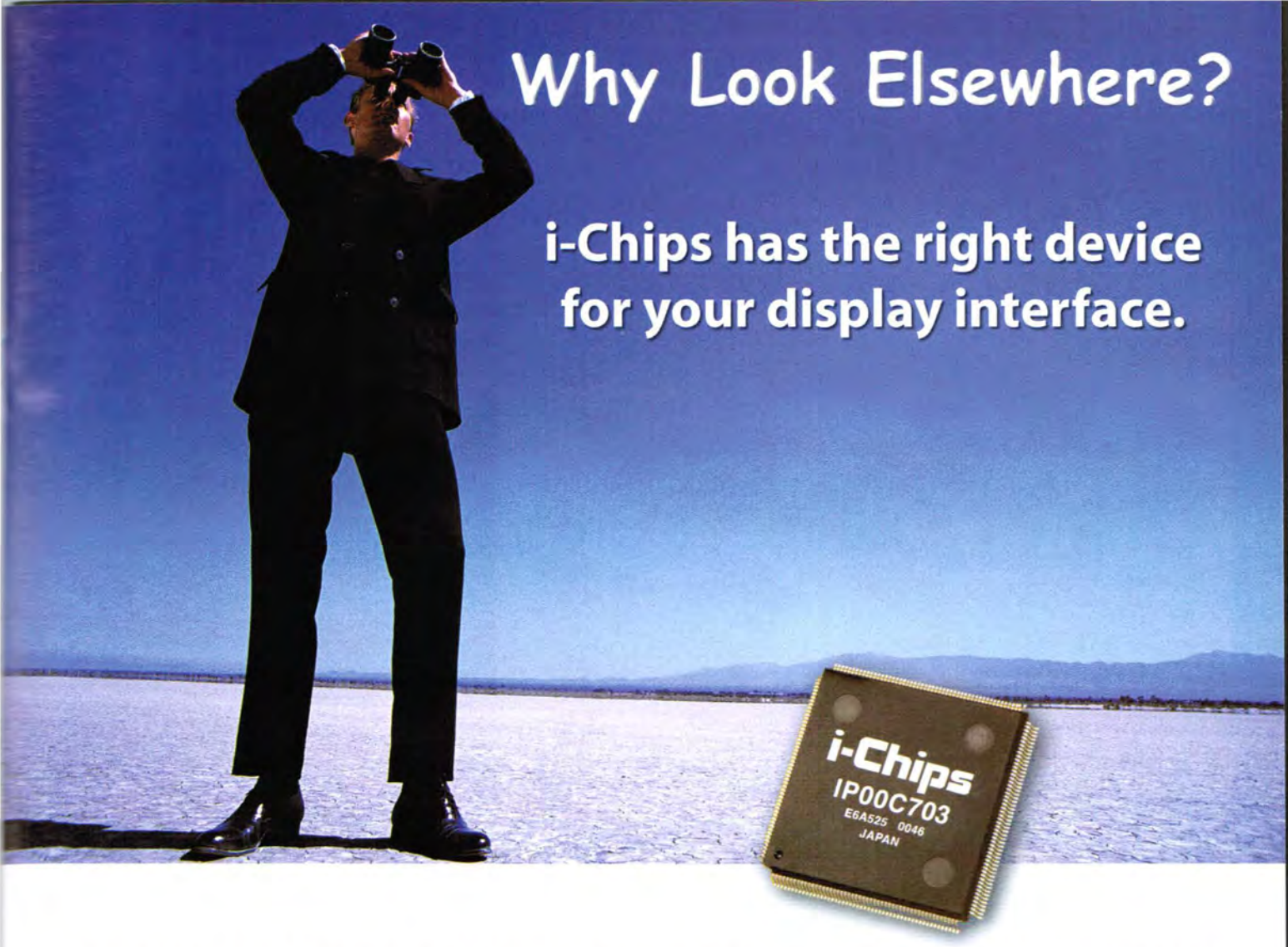
First to market with passive OLEDs (announcing sampling in June 2001), ***Philips Mobile Display Systems*** continued its aggressive passive-OLED roll-out at SID 2002. The company announced an OLED development kit for delivery in July/August of 2002, and demonstrated an electronic shaver equipped with a 160 × 80-pixel green OLED that parent Philips will shortly be selling in the U.S. Moreover, the company demonstrated a developmental – "still two years out," according to van de Ven – super-thin OLED, which replaces the top glass substrate with a layer of thin films.

As for ***SK Display Corp.***, the recently formed joint venture of Eastman Kodak Co. and Sanyo, it announced an LTPS OLED design kit at SID 2002 which is expected to be available in July. The SK 2.16-in. OLEDs are clearly ready for prime time, demonstrating excellent color performance on all fronts. Design kits for larger-sized displays will be announced later this year, according to Leslie Polgar, President of Kodak Display Products.

Except for the Noritake nanotubes, FEDs could not be found on the SID 2002 exhibit floor. "It seems SID has survived the virtual disappearance of FEDs quite easily, replacing it with OLEDs," said Stewart Hough, Vice-President of Business Development at Cambridge Display Technology. "The Sony dis-

play looked stunning and the Toshiba display, with the largest size and highest information content to date, all done with ink-jet printing, was very impressive for a first-generation showing."

But occasional rumors of FED activity at some leading display companies bubbled up in the weeks following SID. Perhaps, like turning base metal into gold, some of those rumors will turn into technology demonstrations by the time of next year's SID show in Baltimore. ■



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Microdisplays at SID 2002: Cautious Optimism

Momentum seems to have shifted from LCoS to DMD microdisplays, but interesting LCoS initiatives were on exhibit at SID 2002 – and everybody is waiting for the high-definition revolution to hit the U.S. TV market.

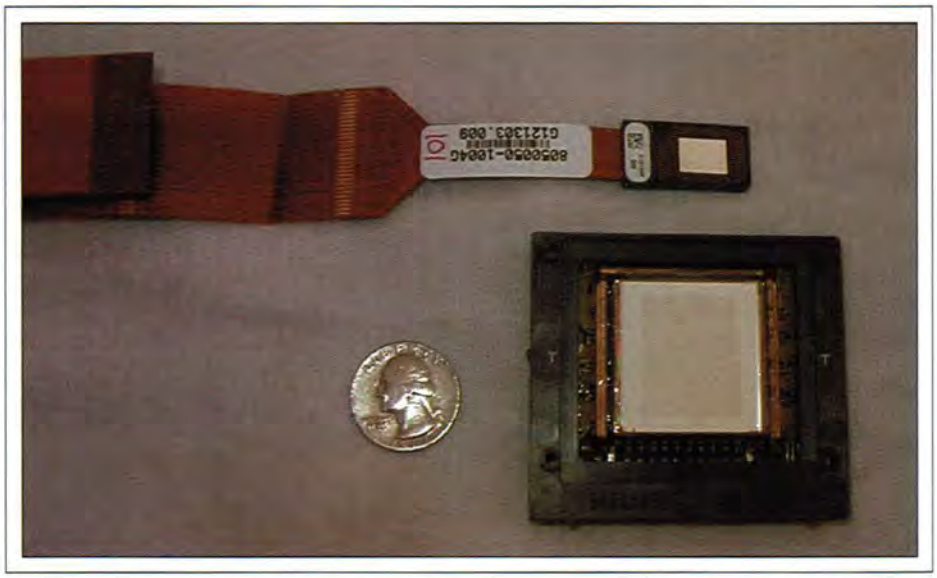
by Stephen P. Atwood

THE MICRODISPLAY COMMUNITY came to the SID International Symposium this year expressing hope and cautious optimism after what can arguably be described as a brutal past year. Some companies that were attention-getters last year were not even in operation by SID this year. Some were much more streamlined versions of their former selves, and others were in the process of reorganization to take on new shape and strategy. Still, when one discounts the unrealistic expectations set by some, the community achieved some remarkable milestones over the past year and showed that there are quite a few viable microdisplay technologies worthy of appreciation.

The performance of reflective liquid-crystal–on–silicon (LCoS) devices used in projection engines has improved dramatically, a result of advances in engine design and the LCoS technology itself. ***Three-Five Systems*** and ***Philips*** both presented demonstration consumer-television products made from LCoS panels that seemed to perform better than any CRT-projection versions, and well within the minimum standards for consumer acceptance. Most impressive were the uniform contrast ratios, which both companies believe can be better than 400:1 in production units.

Kopin's transmissive LCoS technology continued to improve in both resolution and transmission. They demonstrated a wide variety of color-sequential near-to-eye (NTE) embodiments. Kopin was also showing their new SXGA devices which can be used in monochrome applications or in a three-panel configuration for full color.

Organic light-emitting-diode (OLED) microdisplays were demonstrated by ***eMagin Corp***. in a variety of NTE embodiments covering 2-D color, 3-D color with head tracking, and transparent monochrome applications. With a brightness of better than 100 cd/m^2 and



Stephen P. Atwood

Philips expects to have an SXGA version of its relatively large engaze™ *LCoS microdisplay for single-panel rear-projection TV (bottom) commercially available later this year. At over 1 in. on the diagonal, it dwarfs another LCoS microdisplay, the 0.5-in. unit from Three-Five Systems (top).*

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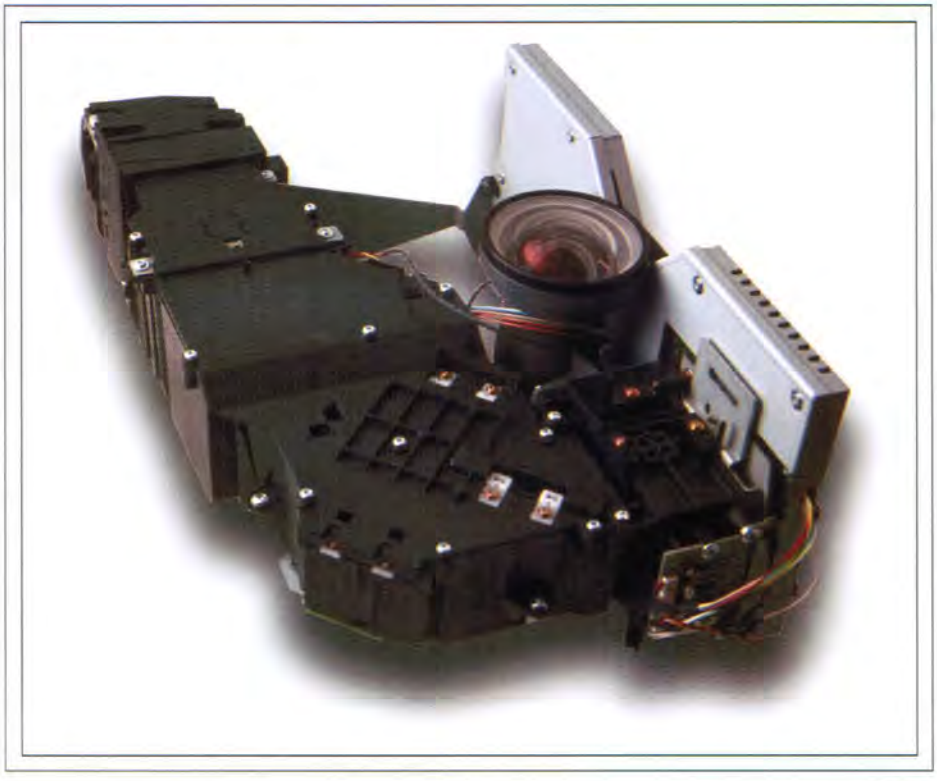
SVGA+ resolutions (852 × 3 × 600 pixels), eMagin has made significant advances in their devices that enable some promising NTE implementations.

It has been several years since Texas Instruments exhibited its reflective microelectromechanical-system (MEMS) microdisplay at SID – the Digital Micromirror Device™ (DMD™) – or the Digital Light Processing™ (DLP™) technology of which it is part. But a number of key projection-component makers, including ***Unaxis***, were on hand to show their new advances in dichroic mirrors, scrolling-style color wheels, and lamps. These advances continue to make the field more promising for MEMS as well as other technologies.

The question that many were discussing was What will be the killer application for microdisplays? Arguably, what hurt the makers of most microdisplays in 2001 were the overall economy, performance problems with some specific designs, and a frustrating lack of high-volume applications. The largest sales volumes for microdisplays today are in camera viewfinders, which are dominated by traditional polysilicon LCDs. LCoS devices have started making good inroads into this market – 1 million units or more in annual volume. Other NTE applications have suffered especially hard due to ergonomic issues that are still not thoroughly resolved. With that said, key demonstrations this year proved that the microdisplays themselves are now ready to enable a better class of NTE products. Most of the visual issues with LCoS frame-sequential color seem to have been mitigated by frame rates of 80 Hz and higher. There are still some lifetime concerns with OLED devices, but eMagin believes they have made significant progress and that lifetimes are just fine for a typical-duty-cycle NTE product.

In other application areas, volume has been much harder to come by. One often-articulated strategy is to position microdisplay projection engines, generally based on LCoS or MEMS technology, as "the perfect platform" for consumer HDTV. It is generally expected there will be a substantial opportunity to sell replacement and upgraded TVs as format conversion in the U.S. and other countries marches on, and that this transition will be substantial enough to support tremendous volumes for panel manufacturers.

Companies demonstrating LCoS technology, in particular, frequently argued that they had or will have the best price/performance advantage over direct-view or other panel technologies for large-format HDTV products. In fact, every reflective-LCoS-product manufacturer interviewed said that its devices would make significant gains on the consumer side of the projection market because of their capability to provide a much lower system cost than other solutions, including MEMs, and do so with "good enough" performance. To prove this, several companies have now produced their own light-engine designs to speed adoption, a strategy reminiscent of Texas Instruments' approach early in their introduction of DMDs.



Philips

Shown is Philips's scrolling-color light engine, which incorporates the engaze™ *panel.*

However, it was hard, but not impossible, to get anyone to suggest that a reflective LCoS projector could be optically *better* than a similar MEMS design. This is not a new debate – even between projection *vs.* direct-view in the consumer-TV market – and we will certainly have many more SID symposia before the answer is clear.

SpatiaLight

One of the most vocal advocates of LCoS technology for consumer TV was Dr. Piaget of ***SpatiaLight, Inc***. SpatiaLight operates as a fabless R&D company that focuses its resources on technology development while working with partners to actually fabricate their panels. The company offers a 1280-horizontal-pixel vertically aligned nematic (VAN) liquid-crystal analog-input panel in both 4:3 and 16:9 aspect ratios, which are the most common formats available. The panels are said to have a peak reflectivity in the white state of better than 70% and can potentially achieve a 1000:1 contrast ratio.

To produce an optical engine that was optimized for its panels, SpatiaLight teamed up with Fuji Optical. The result is a field-sequential-color projection engine that SpatiaLight specifies at a 350:1 contrast ratio (a company spokesman said they believe the engine can actually produce more than 500:1). The demonstration unit at SID 2002 was meant to show off the Fuji Optical engine and the SpatiaLight panel in a typical configuration.

From a business perspective, SpatiaLight believes it has a product ready and needs a hungry market. It has focused its efforts on proving its model in mainland China, where,

Ken Werner

The Philips 44-in. 16:9 rear-projection LCoS television prototype was shown at SID 2002.

working with China Electronics Corp. (CEC) and others, it hopes to demonstrate the acceptability and price/value capabilities of large-format rear-projection LCoS HDTVs. Chinese consumers today buy more than 300,000 projection TVs annually at an average price of $3500. With the conversion to HDTV, Dr. Piaget thinks this market will grow to over one million units next year and three million per year very soon. The Chinese Government seems more determined than the U.S. Government to stimulate propagation of HDTV, so this may be a faster test bed than the U.S. market.

Philips Components

Also enthusiastic about HDTV, ***Philips Components*** demonstrated its prototype reflective LCoS high-definition consumer television. The screen measured 44 in. on the diagonal with a 16:9 aspect ratio and used one LCoS panel in frame-sequential mode. The brightness uniformity of white images was good but not great. By utilizing their scrolling-color prism technology and a relatively slow color field rate of 180 Hz, they achieved very good color saturation and brightness with negligible visible frame break-up. In traditional color-sequential designs, the color field rate needs to be much higher – 240 Hz or more – to avoid visible break-up when the screen is viewed using peripheral vision. The scrolling-color prism technology helps to diminish this artifact.

The Philips LCoS panel – tradenamed *engaze* – is unusual compared to other offerings because it is much larger, over 1 in. on the diagonal, and uses a pin-grid-array (PGA) connection scheme. Panels from many other LCoS companies, such as Three-Five Systems, are much smaller, often less than 0.5 in. on the diagonal, and use a flex lead for their connections.

Typically, projection-engine designers want the panels as small as possible to help enable smaller and more efficient light paths and to minimize weight. When asked about his company's choosing to produce a large-format device, the Philips representative explained that they chose the larger format to reduce risk and shorten time to market over their competitors.

Philips's business model includes licensing the reference design for the projector as well as producing its own consumer-TV products.

eMagin Corp.

eMagin Corp. showed an effective 3-D headset with head tracking which it hopes will be a gamer's delight.

The company expects the panel to be available later this year in an SXGA format, with the wide-HDTV format to be available next spring. Apparently, Philips is focused squarely on the U.S. and European markets, and is able to wait longer for those markets to develop than some of its competitors may be.

Three-Five Systems

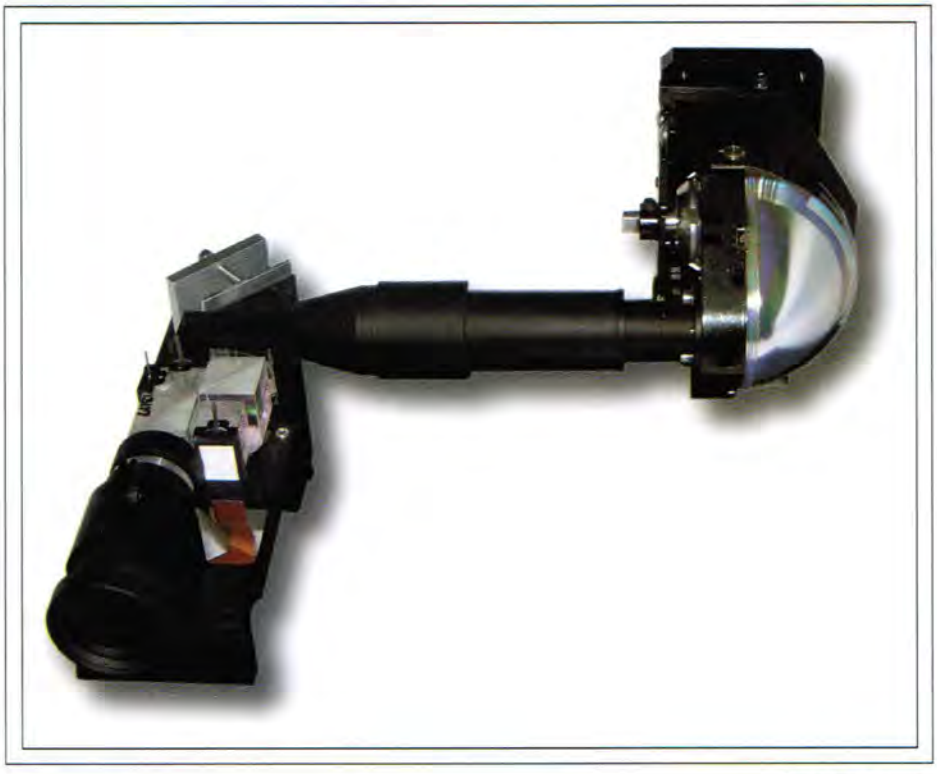
By the opening of the SID exhibition, ***Three-Five Systems*** had been on a small buying spree, recently acquiring the technology of both Zight and InViso to add to their own significant portfolio of LCoS technology. Three-Five offers a significant portfolio of LCoS panels with pixel formats ranging from at least 800 up to 1920 horizontal pixels. The higher-resolution devices are targeted at three-panel rear-projection applications for, of course, consumer HDTV. A quick scan of the company's data sheets shows that all of its high-resolution panels are specified at a contrast ratio of 600:1 or better and almost all at 70% or better peak reflectance. Three-Five Systems' NTE offering is designed to be used in color-sequential mode.

In addition to producing panels, Three-Five Systems teamed up with Wavien, Inc., Advanced Digital Optics, and ColorLink, Inc., to produce an XGA three-panel light engine. By providing a light engine, the partners hope to speed adoption of LCoS into consumer-TV designs. The engine assembly, including panels, is specified at a contrast ratio of greater than 300:1 and a luminance of 250 lm or more in a 43-in.-diagonal screen. These numbers seem lower than the claims of some other manufacturers, but Three-Five Systems' demonstration was visually impressive.

Three-Five Systems was also demonstrating a variety of clever NTE implementations by customers including Hitachi, Visys, and Mobintech. All met expectations and showed the continuing advances in NTE optics. Although some of the implementations seemed like good product ideas, none is destined for immediate high-volume adventure.

eMagin Corp.

It was very encouraging to see ***eMagin Corp***. at the exhibition after their recent struggles to keep operating. Their demonstrations included a number of NTE applications, but the most interesting were their new 3-D head-tracking goggles developed in partnership with the VRX Technologies Group.



Three-Five Systems

Three-Five Systems teamed up with Wavien, Advanced Digital Optics, and ColorLink to produce this XGA light engine, which uses three microdisplays from Three-Five Systems.

Using a special version of their SVGA OLED display ($800 \times 3 \times 600$) with left- and right-eye stereovision electronics embedded directly in the display substrate, they were able to create a realistic-feeling 3-D experience with two panels and a fairly lightweight headset.

By integrating the 3-D image processing and allowing the left- and right-eye panels to communicate directly with each other, the company has eliminated a significant amount of external circuitry. The brightness and resolution of the combined displays were more than sufficient to make the application acceptable. eMagin was also showing several embodiments of their new full-color SVGA+ OLED, which has slightly more horizontal resolution than standard SVGA and supports both 16:9 and 4:3 aspect-ratio image formats. As mentioned earlier, there are still some lifetime concerns with OLED devices, but eMagin believes that their devices can easily meet 10,000 hours or better, which is arguably just fine for an NTE product with a typical duty cycle.

Kopin Corp.

Kopin Corp. was also demonstrating a number of NTE applications, which were designed around the company's transmissive LCoS technology tradenamed Cyberdisplay™. This is a relatively mature technology, and Kopin has recently begun to stretch it somewhat from the original QVGA device that ships in high volume to VGA and SXGA versions for both commercial and military applications. The most interesting VGA application shown was a viewfinder-style global positioning system (GPS) receiver with a full-color field-sequential display. The color field rate was 80 Hz; some frame breakup was visible, but the overall performance was good for the application. The brightness of these devices appeared a bit lower compared with that of OLEDs, but not enough to be really detrimental.

Scipher, PicVue, and MicroVue

Another intriguing demonstration was of the ***MicroVue*** SXGA ferroelectric LCoS (FLCoS) panel technology. Born of technology

licensed from Scipher plc, MicroVue and its manufacturing partner PicVue have begun producing these devices to be used in single-panel projection systems for (of course) consumer rear-projection HDTV. FLCoS technology is promising because it has very fast switching speeds, which at one time meant the difference between a single-panel and a three-panel implementation. The device is fairly large at 0.88 in. on the diagonal and has a native resolution of 1280 × 1024 pixels. MicroVue specifies reflectance at 70% or higher and a minimum contrast ratio of 200:1. Color is achieved by field-sequential methods. In FLCoS systems, unlike other LCoS systems, gray scale is produced by temporal dithering, which is appropriate because of the very fast switching speed of FLCoS technology.

At SID 2002, ***MicroVue*** was demonstrating a color-sequential projection system with a pixel format of 1280 × 1024 and a frame rate of 120 Hz. This corresponds to a color field rate of 360 Hz. Color-frame break-up was not observable at any time, and the overall color and brightness uniformity was acceptable.

From a business perspective, MicroVue and PicVue are investing very heavily in this technology, with a new manufacturing facility in Taiwan capable of several million panels per year by the end of 2003. This comes at a time when the only other FLCoS company, DisplayTech, which already manufacturers NTE products in high volume, has chosen to move out of the projection market.

MicroVue has invested significantly in its IP portfolio and believes it can beat Texas Instruments on price by a substantial margin with comparable performance. Therefore, the company believes it can contend in both the consumer-TV market and in the front-projection business market. This is a more aggressive vision than was conveyed by the other LCoS companies interviewed.

This past January at the Consumer Electronics Show, Texas Instruments and its customers moved aggressively into the consumer projection market, and seemed to have captured the momentum from LCoS. The evidence at SID 2002 was that the LCoS contingent is consolidating around its strength in NTE products on the one hand, and regrouping for further assaults on the consumer projection bastion on the other. It will be an interesting year. ■

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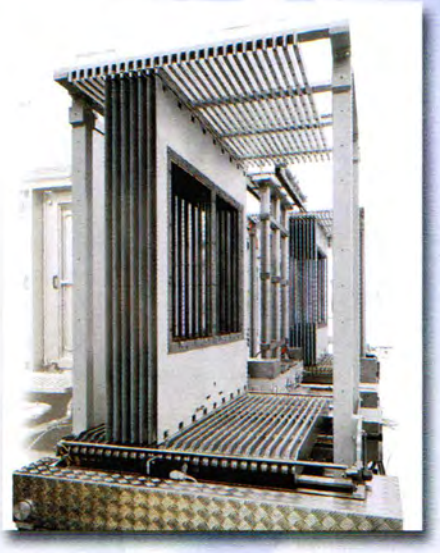

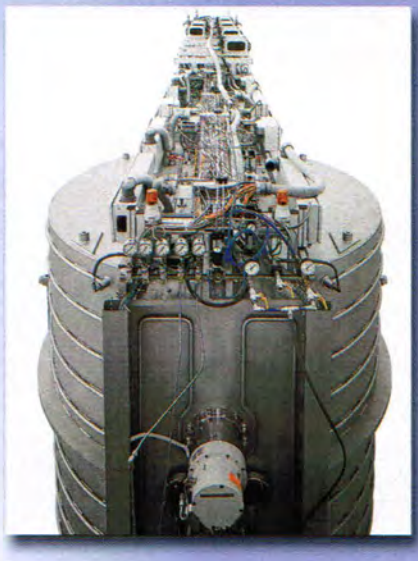

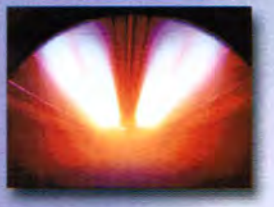

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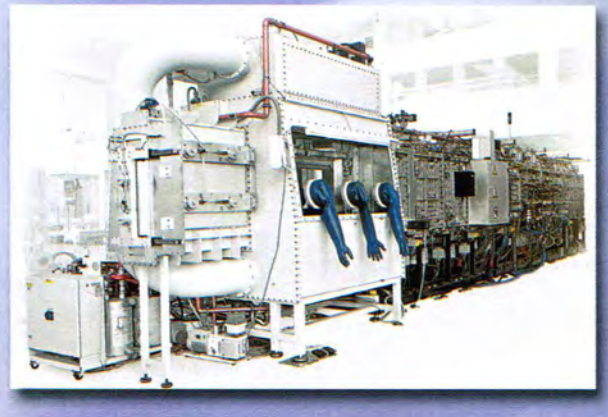

The emerging OLED application is a technology priority for Applied Films. As part of the "OLED Consortium", we work together with research institutes and commercial companies to accelerate development of suitable mass-production processes and equipment for OLED devices.

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The Stuff of Which Displays Are Made

Components, equipment, and materials were all over the show floor at SID 2002, reflecting – and perhaps predicting – the changes in display technologies and products.

by Pat Dunn

THERE were 264 exhibitors at the SID 2002 exhibition, and most of them were suppliers of components, equipment, or materials. Most of the media news hounds could be found sniffing around the booths of the leading display suppliers and emerging-technology companies, but this article highlights particularly interesting material and equipment exhibitors. Given the size of the SID show, omissions are inevitable – but they are not intentional.

OLED/FPD Manufacturing

OLEDs and PLEDs made their presence felt this year and were on display by industry leaders such as Sony, Toshiba, Samsung, Philips, and many others.

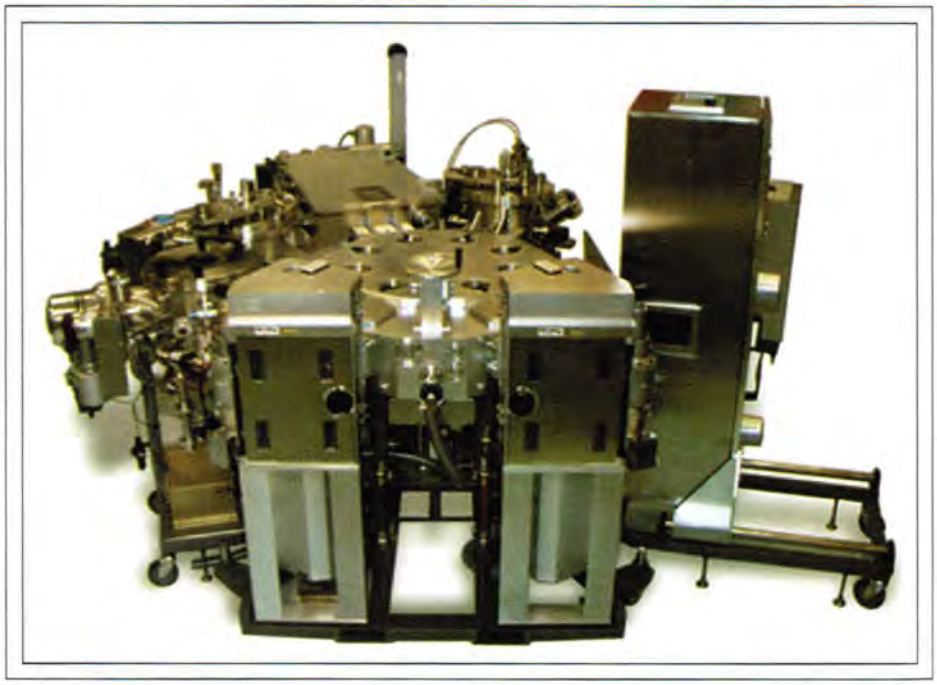
Kurt J. Lesker Co. (www.lesker.com) was talking about its OCTOS cluster tool, which is designed for pre-production and production-scale processing of 6-in.-square OLED substrates. The OCTOS provides exceptional layer-thickness uniformity, repeatability, and reliability. Its features include a reactive plasma cleaning chamber, a robotic central distribution module, an organic deposition chamber with three cluster modules (each with three low-temperature evaporators), a linear sputter-deposition chamber with two sources and complete mechanisms for linear transfer, a metal-deposition chamber with four thermal boats, a shadow-mask storage chamber, and entry and exit load locks.

Nikko Materials (www.nikkomaterials.com) is a subsidiary of Japan Energy Co. that manufactures high-purity metals and wafers used in the microelectronics and communications industries – primarily sputtering targets for the manufacture of semiconductors, data-storage devices, and optical films. Nikko was displaying InP and CdTe wafers, which are widely used for compound-semiconductor and IR-sensor applications, as well as ITO targets for TFT-LCD and other flat-display manufacturing applications.

Display Lighting

This is a very broad field, and many suppliers were on hand to show their wares. These products are primarily backlights for LCDs, but also include lamps for projection systems.

Global Lighting Technologies (GLT) (www.glthome.com) was on hand to discuss its custom backlight-module business. GLT is a worldwide manufacturer of backlight assem-



Kurt J. Lesker Co.

Kurt J. Lesker's OCTOS cluster tool is used for processing 6-in.-square OLED substrates.

Pat Dunn *is Director of Technology for the market-intelligence firm DisplaySearch, 1301 S. Capital of Texas Hwy., Suite B125, Austin, TX 78746; telephone 512/459-3126, fax 512/459-3127, e-mail: Pat@display-search.com.*

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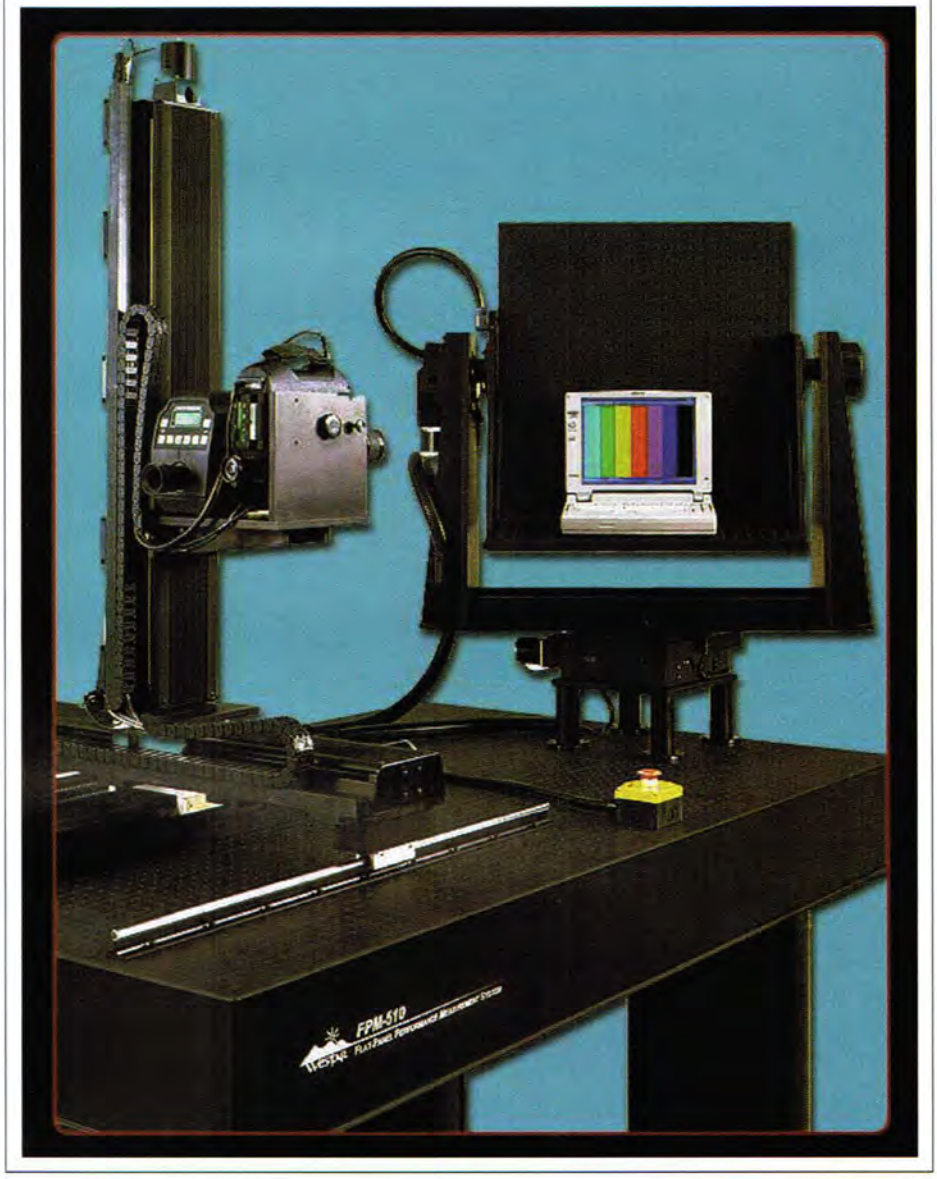
blies, with facilities in Shanghai and Suzhou, China, and Taipei, Taiwan. It has intellectual property that covers techniques in forming Microlenses™ for uniform backlighting and also for the integrated molding of LEDs into the plastic waveguides, which improves efficiency. GLT has sales and engineering personnel throughout the world, and uses CAD/CAM techniques to achieve its designs.

OSRAM Sylvania (www.sylvania.com) announced the expansion of its P-VIP family of super-high-pressure mercury lamps for front- and rear-projection displays. Especially intended for étendue-critical applications such as DLP-, LCD-, and LCoS-based projection systems, these lamps provide a very short electrode gap with a high luminous output. The lifetime of the lamps ranges from 1000 to 6000 hours, with power ratings varying from 100 to 250 W.

Ushio America (www.ushio.com) was also presenting its line of lamps for projection applications. Ushio has developed a line of lamps for a full range of projection systems and has several manufacturing facilities worldwide, all of which are ISO 9001 certified. Ushio's main offerings have been 150–600-W short-arc mercury EmArc™ lamps (for use in high-intensity ultraviolet adhesive-curing applications) and other high-pressure discharge lamps.

BKL (www.eluminate.com) showed its line of electroluminescent lamps for backlighting LCDs. BKL is an ISO 9001 and QS-9000 certified global manufacturer, and specializes in high-volume applications requiring tight tolerances and high-performance requirements. BKL uses a highly automated screen-printing technology utilizing advanced microencapsulated phosphors to produce EL lamps with high brightness, low power consumption, and better moisture resistance – and, consequently, long life.

PerkinElmer Optoelectronics (www.optoelectronics.perkinelmer.com) introduced its 200-W xenon/mercury discharge lamp which is known as the XHP 200. It is designed primarily for projection applications using LCD- or DMD-based technology. Its advantages include a small plasma ball for maximum collection efficiency with small reflectors, very high luminous flux, high luminous efficacy, long life, and stable color temperature. The XHP 200-W lamp is among a wide array of lamps using custom parabolic and elliptical reflectors manufactured with an electroplating process. Some key advantages of this process are that it reduces the lamp's weight, provides consistent curvature, allows special-feature add-ons such as mounting holes, and increases durability and ease of alignment.



Westar Corp.

Westar's automated test system.

Display Films

This category was well represented at SID 2002. Many LCD and system suppliers are trying to add value to their products by increasing the scope of applications, and films help them do it.

3M Touch Systems (www.3Mtouch.com/info/pr) announced several new products at this year's show, including the new MicroTouch™ M150 flat-panel-display touch monitor, which uses an integrated touch screen. The monitor uses 3M's exclusive MicroTouch EX II drive electronics and is available with a MicroTouch-branded screen using ClearTek™ capacitive or five-wire resistive touch-screen technology. The monitor is intended for use in kiosks, POS, and other industrial/commercial applications. The other announcement

DisplayCheck

DisplayCheck's rack test system for LCoS microdisplays.

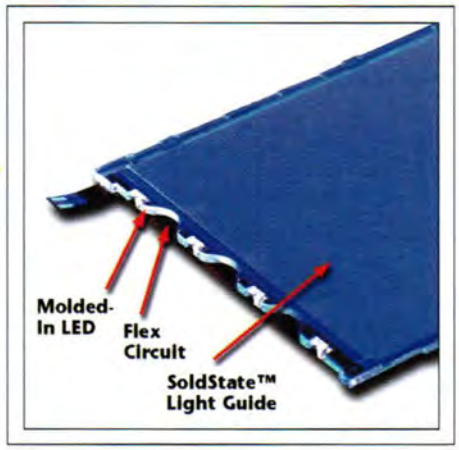
from 3M was the MicroTouch five-wire resistive touch screen, built at its Resistive Center for Excellence in Milwaukee, Wisconsin. This announcement broadens 3M's resistive touch-screen line to include four-, five-, and eight-wire film-on-glass (FG) flat resistive touch screens.

Nitto Denko (www.nitto.com) announced its new linear polarizing film, the ARC-150. This film incorporates an anti-reflective (AR) coating on top of an anti-glare (AG) surface, which reduces glare from ambient light by more than 75% while also eliminating blur and sparkle from higher-resolution LCDs. Nitto also announced it is supplying manufacturers with prototypes of its next-generation film, the ARC-3, which is designed to reduce surface reflections by more than 90%.

CYRO Industries (www.cyro.com) announced new films at the show, namely, its acrylic ACRYLITE® anti-reflective sheet, its PMMA-based ROHOGLAS® 99526 film, and polycarbonate-based EUROPLEX® 99506 film. The ACRYLITE film uses an AR coating for glare reduction in flat-panel displays, and is chemical and abrasion resistant. CYRO had steel wool in the booth for customers who wanted to try to scratch the film – I could not. The ROHOGLAS and EUROPLEX films can be laminated to other surfaces as a hard cap layer, and have high transmission and low birefringence. The ROHOGLAS is the hardest uncoated film on the market, with a 4H pencil hardness, and EUROPLEX offers high impact resistance. Applications for both films include PDAs, touch screens, and flat-panel monitors.

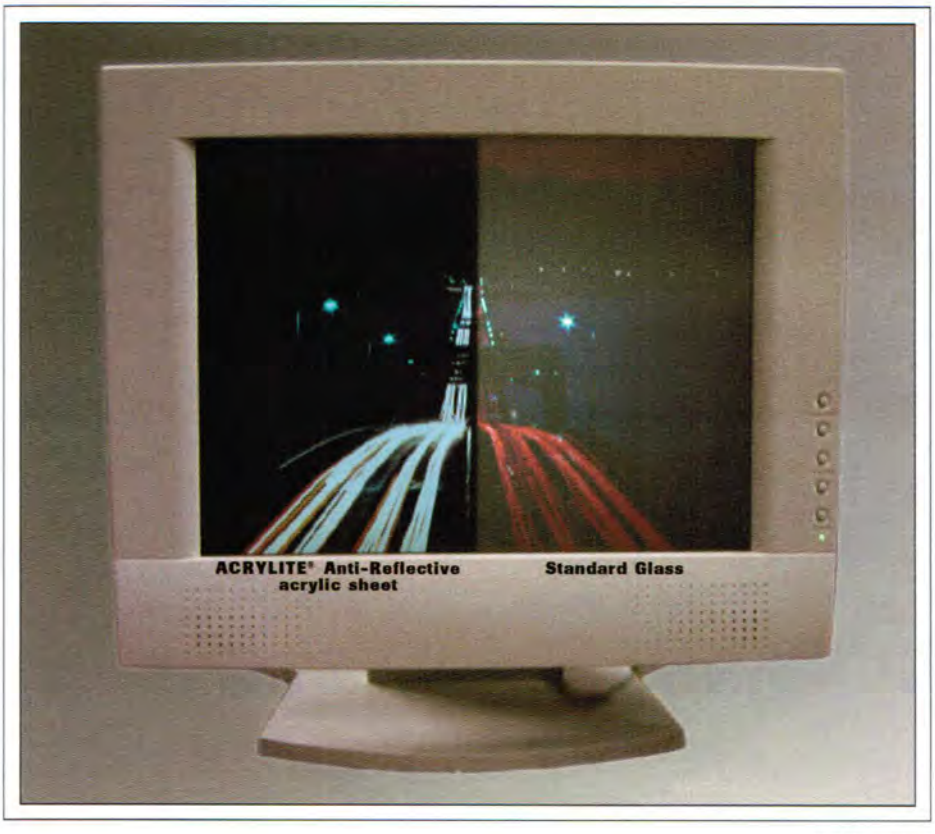
Zytronic Displays Ltd. (www.zytronic.co.uk) showed its touch screens and ZYSHIELD optical filters. Zytronic manufactures optical films and also integrates them into TFT-LCD modules for use in kiosks, public telephones, *etc.* Zytronic announced a recent design win in Marconi terminals being installed in British Telecom (BT) phone booths throughout the U.K. Other optical-filter products shown include Hitrans™ heater panels, RFI- and EMI-shielding optical films, AR coatings, and many others, including circular polarizers.

Fujitsu Components America (www.fcai.fujitsu.com) announced its new FID-554 series of resistive touch-screen panels with 85% transmittance, intended for LCD applications. The four-wire panels use a proprietary AR coating and are available in 0.7-, 1.1-, and 1.8-mm glass thicknesses. They have a minimum 3H pencil-hardness rating, are available in a variety of sizes, and are intended for use in desktop monitors, notebook PCs, handheld computers, and pen-input PCs such as PDAs. The FID 554 series is priced from $15 to $90 in OEM quantities, depending on panel size.



Global Lighting Technologies

Global Lighting Technologies (GLT) has a proprietary technique for molding LEDs into the plastic waveguide of its backlight modules for greater efficiency.



CYRO Industries

CYRO Industries introduced several new products at SID 2002, including its ACRYLITE™ acrylic anti-reflective sheet.

Also announced were the FID-55x series touch panels, which boast a 90% transmittance and command a 2× price premium over competing technologies. Both announced panels have a lifetime of 100,000 words.

Ferrania Imaging Technologies (www.ferraniait.com) was showing its products in conjunction with Cleveland-based flexible-display supplier ***Viztec*** and film suppliers ***Promerus***™ (formerly a group within BFGoodrich, now a subsidiary of Sumitomo Bakelite) and ***Sumitomo Bakelite***. Ferrania was formerly the Center of Excellence for photographic technology in 3M's imaging business sector. The primary product lines supplied by Ferrania are the Appear™ 3000, the AryLite™ A100HC, and the Sumilite FST-X014 films, which all have over 90% transmittance in the visible spectrum. The Appear and AryLite films can withstand temperatures of over 300°C.

Display Measurement & Characterization

As the worldwide manufacturing pace for displays continues to accelerate, measurement systems must keep up in order to ensure maximum quality. The systems described here are examples of test units for flat-panel and microdisplay technologies.

Westar Corporation (www.westar.com) continues to develop new test systems for the display industry, including new high-throughput test systems and specialty interface products. Typical Westar testers include the FPM-500, FPM-510, and FPM-520, which are capable of testing displays of various sizes and weights. Westar's systems are totally integrated and automated testers that can measure luminance, chromaticity, viewing angle, gray scale (gamma), flicker and response time, contrast ratio, and many other performance parameters. The systems are capable of testing all flat-panel technologies, including reflective and projection displays. The Westar FPM system is designed for applications including R&D analysis, supplier evaluation, quality assurance, incoming and outgoing inspection, and production lot testing. It can interface seamlessly with virtually any known optical measuring equipment *via* an RS-232 interface.

Minolta Corporation Instrument Systems Division (www.minoltadisplay.com) announced the release of two new products: the CA-210 Display Color Analyzer and the CA-100 CRT Color Analyzer. The CA-210 is intended for use with all of today's FPD technologies. It can perform measurements at a rate of up to 20 times per second and can make reliable measurements with luminance levels as low as 0.1 cd/m^2. The CA-100 can perform measurements at low levels down to 0.5 cd/m^2. They are both USB controllable, and can make color measurements accurate to ±0.002 for white and ±0.004 for RGB using the CIE 1931 standard. Both are software backward-compatible with earlier models.

DisplayCheck (www.displaycheck.com) showcased its line of LCoS testing products, ranging from laboratory and R&D test systems to high-magnification and automated production systems. The systems can measure virtually any characteristic of an LCoS imager, including brightness (reflectance), contrast, response time and flicker, chromaticity, and cosmetic damage (such as scratches, *etc.*), as well as many others. The systems are computer-controlled *via* LabVIEW™ software from National Instruments, and are available in a wide variety of configurations, depending on the customer's specific needs. ■

Circle no. 18

Circle no. 19

THIN FILM DEVICES

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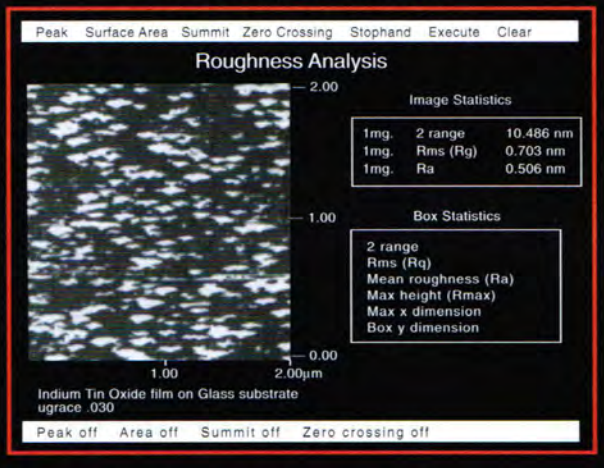
ITO FOR OLED AND LCoS

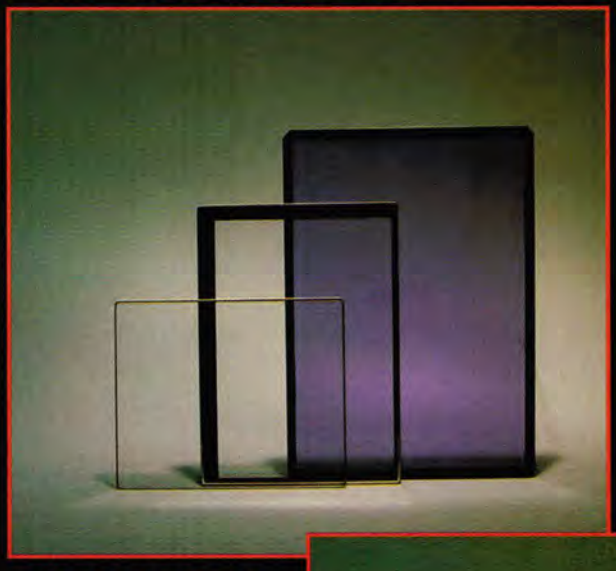


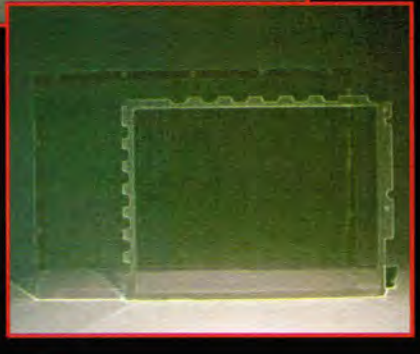
SURFACE ROUGHNESS OF TYPICAL TFD COATINGS			
	Description	Typical Thickness	Roughness*
1	Standard ITO on 1737 glass	1500 Å	±7 Å
2	IMITO to LC	1200 Å	±5 Å
3	BBAR	2500 Å	±20 Å
4	Black CR (Cr203 + Cr)	3000 ± 2000 Å	±30Å
5	Black Nb203	2000 Å	±12 Å
6	Low Temp ITO on Glass	1500 Å	±5 Å
7	Low Temp ITO on Plastic	1500 Å	±7 Å

** No mechanical polish is required. As deposited.*

Nodule Free Coatings

PLASTIC TOUCH PANELS





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Display Electronics Front and Center

At SID 2002, manufacturers introduced major new display-oriented chips, boards, development platforms, and software /n and one promised major shifts in display-system partitioning.

by Ken Werner

IN MANY AREAS, display-panel development is continuing with a competitive vengeance. At SID 2002, we saw impressive advances in OLEDs from Kodak, Sony, and others; developments in displays for portable and automotive applications from Philips, Optrex, Nemoptic, E-Ink, and others; 3-D displays from Actuality Systems, Deep Video Imaging, and DDD; a true 1080-line PDP from Plasmaco/Panasonic; the Samsung/ClairVoyante prototype that promises to improve the price/performance of AMLCD and other matrix displays; an impressive interferometric display from Iridigm; and a much-improved rear-projection scrolling-color LCoS engine from Philips.

Particularly in the mainstream AMLCD applications of XGA laptop-PC screens and XGA and SXGA desktop monitors, OEMs can readily go to any of several Korean, Japanese, and Taiwanese suppliers for genuinely good-looking and reliable displays. Finding such a display and getting it to look good in a product are no longer issues.

So what are the issues? Here are some of them, according to display semiconductor suppliers.

- ***Sharp Microelectronics***. Lower overall system cost, reduced development-cycle time, accelerated product introduction, and quick prototyping of application designs.
- ***Amulet Technologies***. Shorter development time and reduced microprocessor load.
- ***Clare Micronix***. Off-the-shelf drivers for OLEDs and other emerging technologies to shorten development time and speed products to market.
- ***National Semiconductor***. Increased levels of integration and increased system support for customers.
- ***Genesis Microchip***. High integration of video-processing functions.
- ***Philips Semiconductor***. Help system developers enter the market more quickly, increased levels of integration, one-stop shopping, repartitioning of display-centric systems for greater economy.

There is substantial overlap in these assessments, which presumably means the vendors are carefully listening to the same customers

Endicott Research Group

Endicott Research Group showed its new P44W series of fully encapsulated PCB-mountable display inverters for automotive applications.

Ken Werner *is the editor of* Information Display.

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and hearing pretty much the same things. Philips goes quite a bit farther than the others, at least publicly. More about that later. For now, let's take a more-detailed look at what the vendors were showing at SID 2002.

National Semiconductor

Mitch Abbey, Director of National Semiconductor's Display Division, said the overall trend is to greater integration. On laptop PCs, nearly everything is integrated except for the CCFL and inverter. For TFT-LCDs in the future, Abbey expects the RSDS receiver, scalar, and timing controller (TCON) to be integrated on one chip. Their display strategy in general is to "provide a growing array of products offering integrated systems-on-a-chip (SOC) solutions for each functional block of the major market segments, including notebook PCs, flat-panel monitors, digital TVs, CRTs, and small displays for mobile handsets, PDAs, *etc*."

At SID 2002, National Semiconductor introduced the FPD33684 column driver, a 6-bit 384-channel device that supports XGA resolution at a 75-Hz refresh rate. The device is the first in a family that uses reduced swing differential signaling (RSDS™) digital-interface technology. RSDS, which National Semiconductor developed with Samsung, is a derivative of low-voltage differential signaling (LVDS), which is the de facto interface standard for the TFT-LCDs used in laptop PCs. The device uses National Semiconductors's proprietary charge-share technology, which cuts overall display-system power consumption by up to 50% compared with RSDS column drivers that do not use charge sharing, said Abbey.

National Semiconductor also introduced three new CMOS video pre-amps with internal on-screen display (OSD) for CRT monitors. The single-chip pre-amps feature either icon-based or character-based OSD generators. "Our customers, facing tremendous price pressure, limited development resources, and a maturing market, are demanding increasing levels of integration and support from their suppliers," said Muthanna Salman, Director of Marketing for CRT displays. Abbey said that National Semiconductor now has 10–12 design wins for these products.

Endicott Research Group (ERG)

ERG was particularly proud of its new P44W series of fully encapsulated PCB-mountable display inverters for automotive applications. The unit is designed for high-pressure automotive lamps, offers boost current for cold starts, and is built to withstand the shock, vibration, humidity, and temperature range encountered in automobiles. (It has been said that designing for automotive applications is like designing for aerospace at a consumer-electronics price.) There is lots of interest from auto makers and the aftermarket, ERG says.

KenWerner

Applied Data Systems was showing the Phraselator, a DARPA-developed Voxtec-built phrase translator that "speaks" the translated phrase through its loudspeaker. The initial application was for U.S. soldiers in Afghanistan, and one of the loaded phrase translators was English to Dari. Not surprisingly, the Phraselator is built on an ADS SBC.

Applied Data Systems (ADS)

Applied Data Systems' Fred Salloum said, "This is a good show for us. Many people who come to SID looking for LCDs also need single-board computers (SBCs), see them, and start talking seriously. ADS designs and manufactures RISC-based application-ready embedded SBC systems for wireless, mobile, and Internet-connected applications. The company is moving their SBC products to the next generation of Strongarm microprocessor

chips, and are implementing sound and video capabilities. ADS was showing the Phraselator, a DARPA-developed Voxtec-built phrase translator that "speaks" the translated phrase through its loudspeaker. The initial application was for U.S. soldiers in Afghanistan, and one of the loaded phrase translators was English to Dari. Not surprisingly, the Phraselator is built on an ADS SBC.

Sharp Microelectronics of the Americas (SMA)

Sharp Microelectronics's extensive booth had a different look this year. In addition to the wide variety of LCDs that looked very good showing still images, and a couple of Sharp TV sets that were smearing on fast motion, SMA was proudly showing off its new U.S.-developed line of "Blue Streak" microcontrollers (MCUs) and SOC products, which were introduced at the Embedded Systems Conference in March.

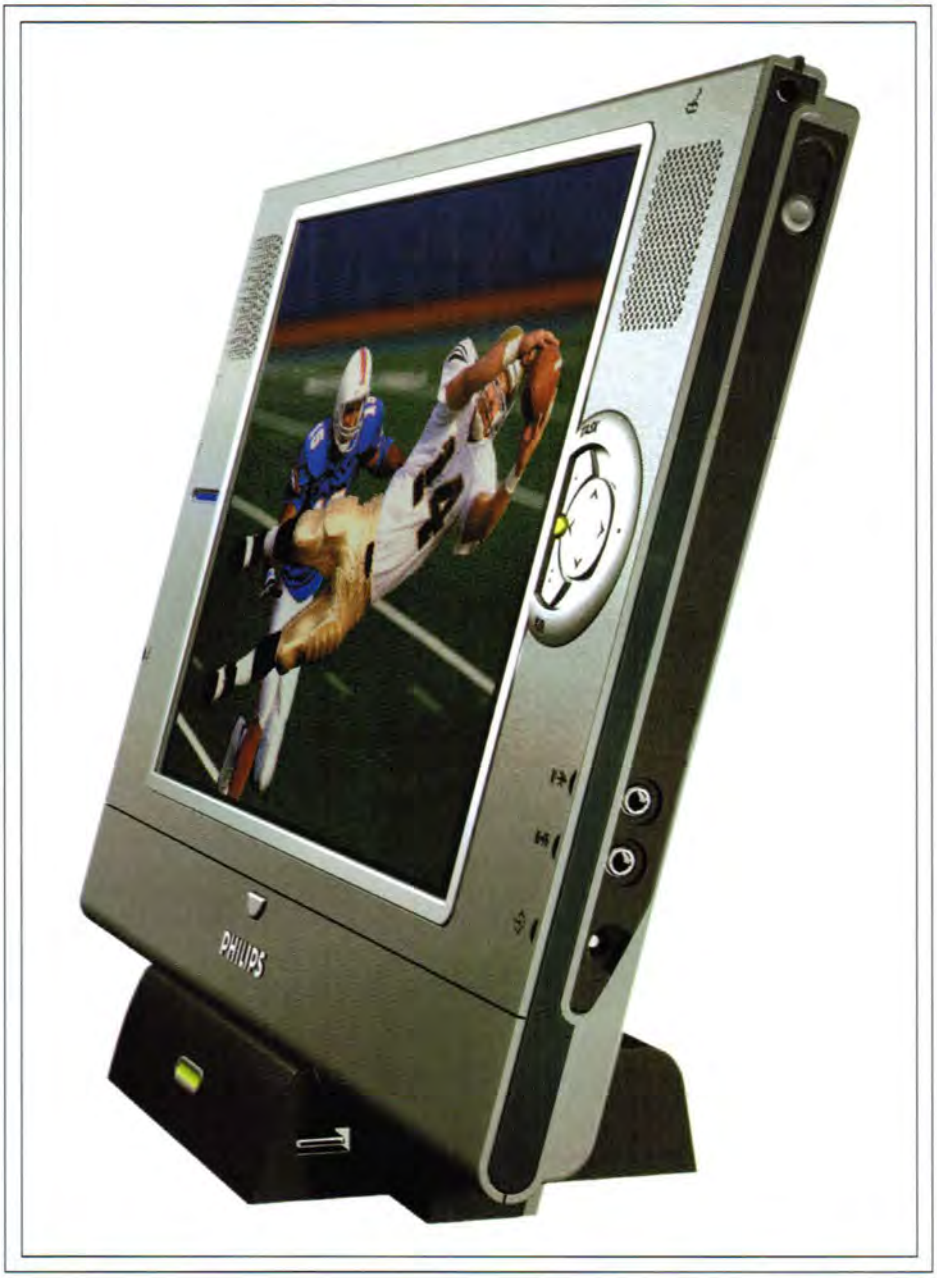
Sharp Microelectronics, located in Camas, Washington, occupies an interesting position in regard to these products. It was designated as Sharp Corporation's North American design center for all MCU and SOC products early in 2001. Manufacture of the products is done not only at Sharp's Fukuyama facilities, but also at Taiwan Semiconductor Manufacturing Company, UMC, and Amkor Technology. Distribution is through SMA and Sharp subsidiaries and partners worldwide.

The first SOC designed at SMA is the LH79520, which combines a 32-bit ARM720T RISC core, DMA controller, vectored interrupt controller, color LCD controller, and 32 kB of local SRAM. Supporting functional blocks include serial interfaces, counter/timers, real-time clock, watchdog timer, PWMs, infrared support, and an on-chip PLL. SMA was also showing its very flexible KEV79520 evaluation board kit for the LH79520, which comes complete with a Sharp 3.9-in. color HR-TFT display. The Blue Streak line is already quite extensive, and Sharp is not bashful about discussing it.

Clare Micronix

Clare Micronix and DuPont Displays announced their collaboration on the design and production of the MXED 301, which "is among the OLED industry's first integrated controller/driver for OLED-display applications incorporating full support for gray-scale and video applications." The controller/driver can support OLEDs up to 128 × 80 pixels, and represents an SOC approach to OLED drivers. Over 60 companies have been sampled worldwide, said Clare Micronix's George Landsburg, and over 20 have placed orders. Orders up to the time of SID were pre-production, and some are now ramping up.

The trick in making such products for OLEDs, said Landsburg, is that they require digital and analog circuitry to be combined on the same chip. Clare Micronix's initial OLED products, announced last year at SID, were off-the-shelf row and column drivers. This year it's the display controller. Down the line,



Philips Semiconductor

Philips Semiconductor was promoting its vision, supported by Philips chips, of various repartionings of the traditional desktop system. One of these was the Philips Mira detachable-monitor prototype with WLAN connection to the host system.

Clare Micronix will combine the controller and drivers in a combination chip, Landsburg said.

He also commented that when a passive-matrix OLED's duty ratio exceeds about 100:1, the drive spikes get too intense, but up to color QCIF or QVGA, passive matrix is okay. Beyond QVGA, one is forced to go to active matrix.

Philips Semiconductor

Jan Pape, General Manager of Philips Semiconductor's Large Display Solutions Business Line, described for *Information Display* a detailed technology roadmap that incorporates increased levels of flat-panel-display (FPD) integration and imaginative repartitioning of the PC/display system.

In a conventional LCD monitor, said Pape, the LCD controller board (containing the MCU and TFT-display controller) and the LCD power board are integrated by the display-system (monitor) integrator, while the TCON and LCD inverter board are integrated with the LCD module by the panel manufacturer. The controller board is connected to the LCD module by a TTL interface. Starting in mid-2002, said Pape, we will begin to see monitors based on "smart integration," in which the TCON will be combined with the display controller chip on the LCD controller board, and the backlight inverter will become part of a combined LCD power board. The TTL interface will now connect this enhanced unit to a "bare" LCD module. In this architecture, the monitor maker has more integration responsibility, but can buy a simpler and presumably cheaper LCD module.

Beginning in mid-2003, Pape sees this architecture being replaced by the "smart panel," in which the combined power/inverter board is integrated by the panel manufacturer, and the MCU, controller functions, and TCON (now all integrated on one chip) are also integrated by the panel manufacturer. Of course, this roadmap is keyed to the availability of the Philips chips that will support it. Among the chips that Philips was featuring was the SAA6714 SXGA triple-input (analog VGA, parallel YUV, and DVI) display controller, which does deinterlacing, movie detection, dynamic noise reduction, upscaling, nonlinear scaling, PIP display, color correction *via* look-up table, and temporal dithering, among other things.

Philips was also touting repartitioning of the PC to integrate many peripherals with the display rather than with the PC. A related concept is the detachable display as found in the Philips Mira and the Sony PC with detachable monitor. Connection to the host is through WLAN. Philips was also touting its chips for implementing cost-effective LCD television.

Pape agreed with National Semiconductor's Mitch Abbey that RSDS is better than TTL, but went on to say, "Improvements over RSDS are clearly possible." At Philips, RSDS is regarded as one more step in the path.

Silicon Image

Silicon Image chose SID 2002 to introduce its Carrera AGP Digital Display (ADD) reference card for bringing the Digital Visual Interface (DVI) to any Intel 845G-based desktop PC with an AGP slot, and at low cost. Designed to be production-ready, the Carrera is intended to be a simple add-in solution that has full hardware and software compatibility, and supports digital display resolutions from VGA to UXGA. The card contains Silicon Image's PanelLink® Sil 164 DVI transmitter chip.

Amulet Technologies

Amulet Technologies was offering free Easy GUI® LCD Starter Kits to journalists, as well as to honest people such as serious potential customers. The kits contain a QVGA display, an integrated analog touch panel, an LCD controller board with the Easy GUI controller chip, and development software. The chip is an ASIC that combines an LCD controller and a user interface engine that eliminates the need to write complex code to draw each pixel on an LCD and develop a GUI. Instead, the developer uses a standard graphics program to create images and standard Web-page authoring tools to create the "page" that will appear on the screen. Then, Amulet's compiler is used to compile the HTML into μHTML, which is used to program the GUI into flash memory. Amulet personnel demonstrated portions of the process, which was impressive.

Genesis Microchip

Genesis Microchip conducted the first public demonstration of its FLI2300 single-chip digital-video-format converter, which incorporates Faroudja's Emmy-Award-winning deinterlacing and video-enhancement technologies coupled with scaling and aspect-ratio conversion. One of the chip's features is Directional Correlational Deinterlacing (DCDi™), which "eliminates the jagged edges seen on moving angled lines in video." The side-by-side demo was impressive. Input resolutions range from 480i through 1080i and SXGA; output resolutions range from 480p to 1080p and SXGA.

For those concerned with copy protection, Genesis makes a variant called the FLI2301, which adds an integrated Macrovision™ copy-protection generator for use in progressive-scan DVD players. And if "legacy" is thought to be a four-letter word, one can buy the FLI2310, which supports digital outputs only. The FLI2300 should be sampling by the time this goes to press. They can be bought for $20.00 each in large volume.

Plastic Logic

Cambridge University spin-off Plastic Logic, Ltd., was happily handing out reprints of the paper it was presenting on ink-jet printing of polymer thin-film transistors for AMLCD applications. Plastic Logic had quite a bit to be happy about, including £6.3 million in first-round private funding and an agreement with Cambridge Display Technology to cooperate on polymer organic electronics, not to mention last year's agreement to collaborate with Seiko-Epson on the development of plastic electronics. Plastic Logic's goal is nothing less than making plastic electronics pervasive. Initial markets are displays and electronic labels.

The Interface Wars

And finally, just as some of us naively thought that the Digital Visual Interface had ended the interface wars and paved the way to a golden digital future, Bob Myers (Manager, Hewlett-Packard Display Technology Center) said in his Friday morning seminar on digital interfaces for displays that DVI has not been adopted at the rate that had been anticipated, although it should certainly not be written off. Part of the reason, Myers said, is that makers of LCD monitors have been clever enough to make the venerable VGA analog interface work quite well with their products. The standard analog VGA interface has a "lousy connector and lousy crosstalk, but it is hard to beat a humongous installed base."

What will it take to justify the wholesale roll-out of a digital interface for desktop monitors? A basic change in the system-monitor model, says Myers. One alternative model is the Digital Packet VideoLink (DPVL), which was introduced at SID 2000 by Hitachi, IBM Japan, Sharp, and Toshiba, and is now the subject of a VESA standards committee.

In this model, the display is a networked peripheral that is updated conditionally, and we move away from the "update-the-whole-screen-over-and-over-again model." The model has very great potential, says Myers, but lots of standardization work is required. A first version – DPVL-Lite – could be implemented on existing DVI and hosts with minor changes to the display. ■

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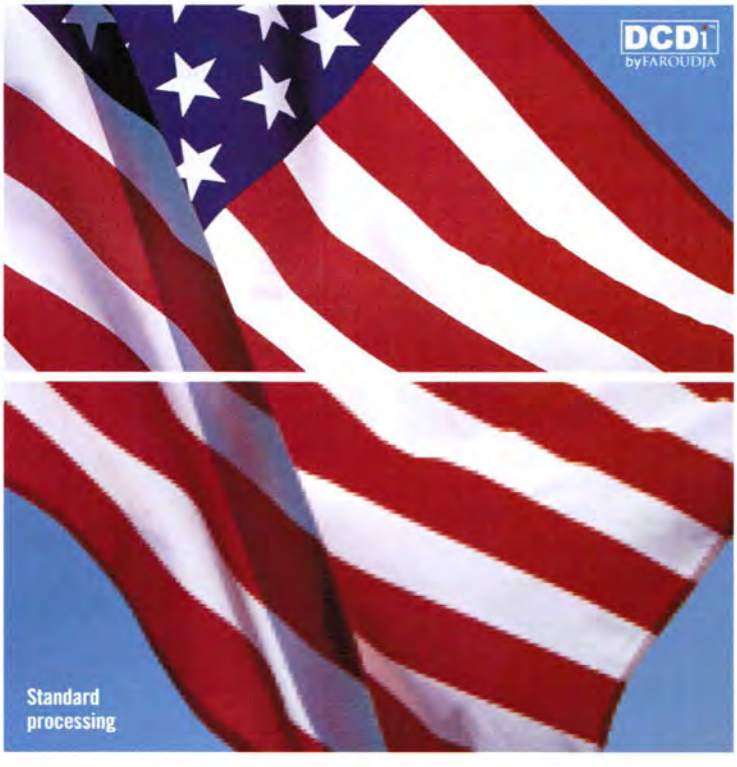

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Growing Up Too Fast?

A casual stroll around the SID exhibition floor is becoming a thing of the past: There is too much to see that is new and interesting, and I am only referring to OLED displays.

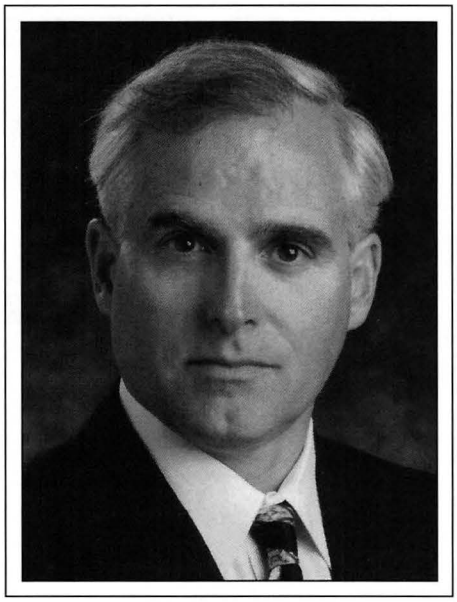
by Stewart Hough

IT seems clear that the display business is male dominated; witness the Evening Panel topic "OLEDs *vs.* AMLCDs: Do OLEDs Have a Chance?" Perhaps a better venue would have been a local boxing ring. I am sure it was all in good fun; after all, no one could really be serious about comparing a technology that has not yet introduced any products to the market with one that virtually owns it.

The display business can be very competitive, so technology comparisons are inevit-able, but proverbial apples-and-oranges comparisons only leave everyone confused. As an industry, we have a big enough challenge defining what a good display looks like, let alone predicting when a promising technology will take over the world's markets – remember FEDs?

Call it overoptimism, wishful thinking, or anticipation anxiety, but there is a strong tendency to underestimate how long it takes for display technologies to get to market. While there have been a few successes (an example of which escapes me at the moment), all the major ones have taken decades to reach their full potential. The display business seems schizophrenic at times; with companies moving at frenetic paces while the rate of display-technology maturation remains glacial by consumer and market time scales.

Although the initial prognosis for OLEDs indicated that strong leveraging of the LCD infrastructure and design similarities with LCDs would rapidly accelerate OLED development and market penetration, the substantial differences have clearly been a major factor in determining the timing for OLED-product introduction into display markets.



More importantly, because the list of major OLED manufacturers is expected pretty much to match the list of LCD manufacturers, there are overriding company-specific business considerations that will drive the timing of market entry. Among these considerations are the perceived threat to core business, the considerable existing capital investment in LCDs, and the risk in introducing a new technology that cannot be manufactured in sufficient capacity to meet expected demand.

Serious comparison of AMOLED *vs.* AMLCD technology in 2002 has about as much value as comparisons of LCDs and CRTs in the early 1990s. Friendly comparisons are always fun, and our human passion for something different will fuel OLED development to its ultimate potential. If OLEDs had a theme song it would probably be the Rolling Stones hit "Time Is on My Side" – yes, it is. ■

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LCDs: Consolidation and Expansion

LCD technology is expanding in all directions, from the smallest displays to large-screen direct-view TVs, and is experiencing a size upgrade every year as it prepares for a major territorial break.

by Jun Hyung Souk

RECENT RESEARCH ACTIVITIES in the liquid-crystal-display (LCD) industry are focused on deviating from the traditional role of LCDs for notebook-PC and desktop-monitor use. This is probably due to a combination of two factors: worries about oversupply in the future and the awareness of rising challenges from organic light-emitting-diode (OLED) displays and plasma-display panels (PDPs). The OLED advancements were receiving "headline" attention on the show floor and in the corridors at SID 2002, but a look at the number of technical papers reveals that the AMLCD technologies continue to dominate the symposium, with approximately 40% of the oral and poster papers combined – four times the number of OLED-related papers.

However, the pressure to achieve the title of "true mainstream display" is an increasingly heavy burden on LCDs. LCD TVs opened a doorway of hope for LCD suppliers, but this business demands many new characteristics that have not been traditional for LCDs, including improved video quality to reduce motion artifacts and super-bright screens to satisfy viewers that have been trained for decades to watch cathode-ray-tube (CRT) TVs.

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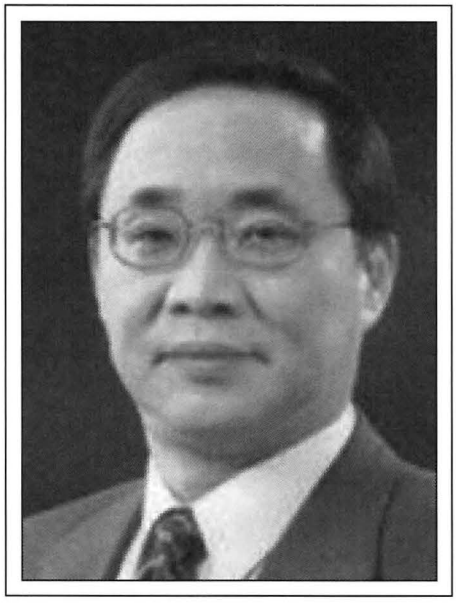
The LCD emphasis has certainly changed, and the focus has broadened from that of the traditional computer-display market to providing high-quality video images as well. The debate on achieving wide viewing angles is over, and attention has shifted to features as improved response time for video performance, improved color capability, and large-sized LCDs for TV and presentation displays. (Examples of these shifts were described during Session 23: Color Vision Issues; Session 48: Video Quality AMLCDs; and Applications Tutorial A-5: Color Considerations for TFT-LCDs.)

Another noticeable area of expansion in LCD technology is advancements in flexible LCDs for electronic paper (Sessions 5 and 10: Electronic Paper I and II and Session 43: Flexible AMLCDs).



For cellular phones with better readability outdoors, tiny reflective or transflective LCDs under artificial lighting continuously drew attention on the exhibition floor.

There is also a progression from concentrating primarily on the panel area to greater concentration on the silicon chips surrounding the panel. In addition to the traditional timing and control chips, newer chips enhance image-quality factors such as color and video-image quality. This broadening of focus reflects a growing awareness that there is a limit to the improvements in screen quality that can be made inside the panel alone, such as faster liquid-crystal response speeds due to advances in liquid-crystal materials and reductions in cell-gap size (Sessions 7 and 14: Image Processing I and II).

Also visible is a distinct trend towards larger direct-view displays, with manufacturers starting to add units to their traditional line-ups, which generally topped off in the 20-in.- size range. Thirty-inch panels are now becoming popular, and many LCD manufacturers were showing such panels at SID 2002. And there was even a 40-in. LCD TV, which challenged the dominance of PDP technology in this size category.

Evaluating these recent activities, we can come to the conclusion that, even though the challenge presented by new technologies is evident, it is far too early to assume that LCD technology will be replaced any time soon. ■

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SID 2002 Honors and Awards

Robert W. G. Hunt was awarded the Gutenberg Prize for work on color image-reproduction techniques, and Alan Sobel received the Lewis and Beatrice Winner Award for longtime service to the Society.

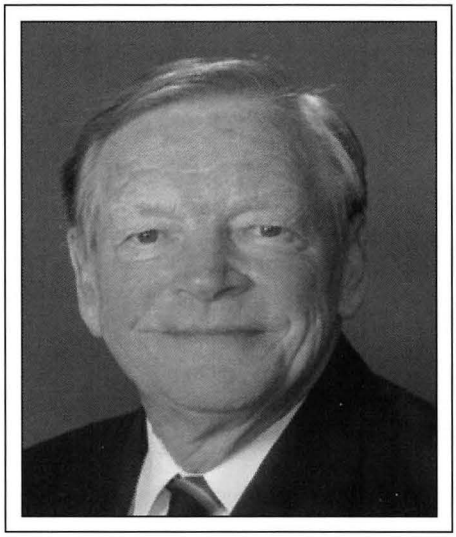
by Stephen P. Atwood

We are often confronted with the terms "product life cycle" or "technology life cycle." But we do not often realize that behind these products and technologies are the professional life cycles of many gifted and talented persons, many of whom have devoted much of an entire career to making one key element a practical reality. This is why the recognition that the SID Honors and Awards Committee gives to honorees at its Monday evening awards dinner is such an anticipated part of the annual gathering of the display clan.

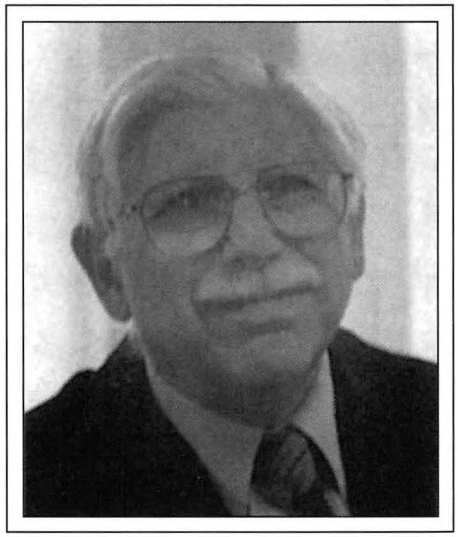
This year the Society bestowed the Johann Gutenberg Prize on Professor Robert W. G. Hunt "For his outstanding contributions to color imaging science and color image reproduction techniques and their application to photography and printing." Prof. Hunt is familiar to almost everyone in the color-science community as a true visionary, and has an enviable array of titles and honors from the most prestigious technical societies. He is a visiting professor at both the City University of London and the University of Derby, England. His professional credentials include 36 years of research work with Eastman Kodak Co. in color science and reproduction, the publication of more than 100 technical papers in various journals, and two separate books on color reproduction and color measurement. Those who attend the Color Imaging Conference, jointly sponsored by SID and IS&T, have heard from him as the keynote speaker nine times (so far). While everyone refers to him as an "expert," Prof. Hunt politely dismisses the title by pointing out that "an expert is someone who has made all the mistakes that can be made in a narrow field of science." His "mistakes" have helped enable the success of the entire photographic and color-printing industries.

The Lewis and Beatrice Winner Award was conveyed this year to Dr. Alan Sobel "For long and meritorious service to SID in a variety of positions, including Editor of the *Journal of the SID*." Alan has been a hard-working member of SID for over 35 years as well as a keen observer of the display community. He was one of the founders of the International Display Research Conference, and continues to work on many program committees. Dr. Sobel's professional résumé includes many years of research work at Zenith on flat-panel technology, the founding of his own research company, Lucitron, Inc., and the publication of more than 60 technical papers and letters.

In his remarks, Dr. Sobel pointed out that this award was of particular value to him because he was a personal friend of one of its namesakes, Lew Winner. He commented on how much displays have become tools rather than exotic accessories, and said that most of the big innovations now appear to be occurring in software, with the advances in image generation and manipulation. Looking forward, he



Robert W. G. Hunt



Alan Sobel

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charged the members of SID to make displays more effective and even easier for users.

Fellows of the SID

The Society also conveyed the grade of Fellow to the following outstanding individuals:

- ***Dr. Philip Bos*** for his contributions to the science and technology of LCDs, especially high-speed, bistable, diffractive, and self-compensating devices.
- ***Dr. Daniel den Engelsen*** for outstanding contributions to CRT technology, especially the development of improved cathodes.
- ***Dr. Nobuki Ibaraki*** for his contributions to the research and development of amorphous- and polycrystalline-silicon TFT-LCDs.
- ***Dr. Shohei Naemura*** for his contributions to the development of liquid-crystal materials for a great variety of display uses.
- ***Dr. Ching W. Tang*** for pioneering and sustaining contributions to organic light-emitting display technology.

Recognizing Special Achievement

Special Recognition awards were conveyed to the following:

- ***Mr. Tei Iki*** for his leading contributions to the evolution of SID into a worldwide international professional organization.
- ***Dr. Junji Kido*** for outstanding contributions to the development of organic electroluminescent materials and devices for displays.
- ***Dr. Taiichiro Kurita*** for understanding image-degradation mechanisms in AMLCDs and proposing methods to reduce these problems.
- ***Dr. Soichiro Okuda*** for his contributions to the development of the computer simulation of CRT components and to the Diamondtron CRT.
- ***Dr. Yoichi Sato*** for his technical leadership in the development and mass production of high-definition PDP TVs.
- ***Dr. Yoshifumi Shimodaira*** for pioneering contributions to the research and development of video image-quality improvements in AMLCDs.
- ***Dr. Sashiro Uemura*** for pioneering contributions to the development of carbon-nanotube field-emission displays.

Acknowledgments

The 2002 Johann Gutenberg Prize and associated $2000 stipend is sponsored by the Hewlett-Packard Company. The Society for Information Display gratefully acknowledges this support.

Serving on the Honors and Awards Committee this year were Carlo Infante, Chris King, Allan Kmetz, Bernard Lechner, Shiego Mikoshiba, Shinji Morozumi, John van Raalte, Larry Weber, and Chair, Andy Lakatos

The work of the Honors and Awards Committee has been led for many years by Chair Andras I. Lakatos, who has brought energy, vision, and wisdom to the post. Dr. Lakatos announced that he is stepping down and turning the chair over to another respected member of the SID community and recent recipient of the Braun prize, Dr. Larry F. Weber. ■

OLEDs *vs.* AMLCDs: Do OLEDs Have a Chance?

There was general agreement that OLEDs will find niches to dominate, but will they displace AMLCDs in laptops, monitors, and television?

by Joe Hallett

MEETING in a town where sports rivalries are legend, two top FPD contenders squared off at the SID 2002 Evening Panel Discussion, where a partisan crowd of nearly 400 enthusiastic fans at Boston's John B. Hynes Convention Center clearly favored AMOLEDs over AMLCDs.

Moderator Paul Drzaic, V.P., Display Technology, Alien Technology, challenged the panel by saying, "Smart and hungry people are betting their careers on OLEDs. Flaws in LCDs are opening the door for OLEDs, and there are 50 different companies presently dedicated to OLEDs. Is it hedging bets or a serious effort?" The panelists responded.

- ***Michael Hack***, *V.P., Strategic Product Development, Universal Display Corp.* "I cannot think of one AMLCD-producing company that has not announced some type of OLED project."
- ***Roger A. Stewart***, *Chief Technology Officer, Alien Technology.* "Some people believe that the future belongs to OLEDs."
- ***Kai R. Schleupen***, *Manager, Design and Electronics, Advanced Display Technology Laboratory, IBM T. J. Watson Research Center.* "Lots of us are scientists. Our interest in exploring OLEDs does not mean it will be a big business."
- ***Jun H. Souk***, *Executive V.P., LCD R&D, AMLCD Division, Samsung Electronics.* "Any company that is serious will put at least ten good engineers on the project – OLEDs deserve at least that much."
- ***Fang-Chen Luo***, *V.P./CTO, AU Optronics Corp.* "We have an OLED team, but that does not mean we are positive about OLEDs. FEDs and electrophoretics used to be hot topics too. Having lots of people does not mean it will be successful!"

Apparently, everyone was willing to concede that OLEDs could perform very well in some specific areas, probably leading to successful niche applications. But there were underlying questions. Can OLED technology reach a critical mass for low-cost manufacturing? Will the current-driven nature of OLEDs prevent them from being used in large-area displays? Will differential aging make it difficult to maintain a stable white balance for video displays? Can the emissive properties of OLED displays make them more attractive than LCDs for the television industry (which demands a wide dynamic range, using terms like "punch" and "sparkle" to describe image quality)? These are application-specific questions, but the answers will impact the long-term viability of OLEDs.

- ***Kai A. Schleupen***. "LCDs currently dominate the notebook market. Since their video quality is improving, LCDs will eventually compete with the CRT in the TV market."
- ***Roger A. Stewart***. "Do OLEDs have to succeed in desktops and notebooks and TVs to be successful? Perhaps not."
- ***Michael Hack***. "OLED problems will be solved just as LCD problems were solved. Their developers are grateful for LCD backplane technology."

Do OLEDs have a chance? The panelists were not shy about taking sides.

- "Absolutely," said Michael Hack. "An emissive display offers full color and wide temperature range. Only selected pixels are illuminated ... power consumption is lower than that of an equivalent backlit LCD."
- "I still believe in LCDs in every respect," said Jun H. Souk. "It has 15 years of proven device technology and a strong infrastructure. Costs are coming down – and performance is improving faster than expected."
- "People prefer to look at emissive displays – OLED is the current emissive display," said Roger A. Stewart.
- "What can be cheaper than AMLCDs?" asked Kai R. Schleupen. "AMOLEDs cannot compete with AMLCDs."

Jun H. Souk questioned the driving force

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behind OLEDs, citing the LCD's challenge to CRTs a decade ago when there was great demand for flat panels. "Now there is not a comparable demand. Semi-reflective LCDs can provide better performance. TFT-LCDs are just entering the market, and will soon dominate that market."

"What is the niche for AMOLEDs?" asked Fang-Chen Luo. Michael Hack predicted that thin light flexible transparent OLEDs would lead to a range of new products, appearing first in small sizes, then slowly increasing over 5–10 years to become a dominant display technology. Roger A. Stewart said, "The niche will be cellular telephones." Kai R. Schleupen said, "It also is a business issue. Manufacturing capacity will produce enough cellular phones in 1–2 two days. What does one then do for the rest of the year?" Fang-Chen Luo said that "to gain a foothold, AMOLEDs must find applications where TFT-LCDs do not work."

The audience had the final word: Cellular phones will not power the industry. We're here because of laptops and television.

As the evening wound down, there were some broad agreement.

- AMLCD technology is the more mature technology, with infrastructure in place to produce panels for a wide variety of applications; color and video performance are improving.
- AMOLED technology is a younger technology that benefits from sharing some AMLCD infrastructure.
- AMOLEDs are being closely watched by AMLCD producers, with most supporting in-house AMOLED R&D.
- AMOLEDs may not immediately fit all applications, but they will find niches where they can be dominant.
- Neither technology is standing still.

This was not your grandfather's sleepy evening-panel discussion. The topic was stimulating, the panel was articulate, and the interactions were competently moderated for the benefit of an attentive audience. There was no consensus about the eventual "winner." But to use an expression familiar to Bostonians, "There's always next year." ■

Outline of LCD/PDP International 2002 — Exhibition and seminar on LCD, PDP, Organic EL, Micro Display and other Flat Panel Displays. It also covers materials, components, production / test / measurement / repair devices, LSIs, softwares, FPD modules and their applied products.

Period: October 30 (Wed.) - November 1 (Fri.), 2002 / 10:00 - 17:00 **Venue:** Pacifico Yokohama, Japan **Organized by:** Nikkei Business Publications, Inc.
Supported by: Ministry of Economy, Trade and Industry (METI) **Specially Collaborated by:** SID (Society for Information Display)
Collaborated by: Semiconductor Equipment Association of Japan (SEAJ), Japanese Liquid Crystal Society, Taiwan Electrical and Electronic Manufacturers' Association (TEEMA), Database Promotion Center, Digital Content Association of Japan
Cooperated by: Nihon Keizai Shimbun **Admission Fee:** 2,000 JPY (Including domestic consumption tax)

Concurrently held: LCD Seminar 2002 / PDP Seminar 2002 / Organic EL Seminar 2002

About Pre-Registration of Exhibition (admission free !) and Seminars

http://expo.nikkeibp.co.jp/lcd/

SID Conference Calendar

Next Show!

The 22nd International Display, Research Conference (Eurodisplay '02)

Eurodisplay '02 will be held in the Acropolis Conference Center in Nice, France, on the French Riviera under joint sponsorship of the Society for Information Display (SID) and Le Club Visu (SID France).

- Two parallel seminar sessions of state-of-the-art lectures will be presented by leaders in the field.
- The three-day conference will feature invited papers, submitted oral presentations, and poster presentations by speakers from around the world.
- Author interviews, with demonstrations, will be held each afternoon to stimulate discussion and promote attendee interaction.
- In parallel to the conference, an exhibition of display components, systems, and related equipment will be held in the Exhibition Center.

2 OCTOBER 02

22nd International Display Research Conference (EuroDisplay 2002)

NICE, FRANCE
OCTOBER 2–4, 2002

• An international conference on display research and development aspects of:
– Display Fundamentals, Display Devices
– Hard Copy & Storage, Input Systems
– Integrated Devices and Applications
– Image and Signal Processing,
– Color Perception, Human Factors

12 NOVEMBER 02

10th Color Imaging Conference: Color Science, Engineering, Systems & Applications

SCOTTSDALE, ARIZONA
NOVEMBER 12–15, 2002

• An international multidisciplinary forum for dialogue on:
– Creation and capture of Color Images
– Color Image reproduction and interchange
– Co-sponsored with IS&T

4 DECEMBER 02

The 9th International Display Workshops (IDW)

HIROSHIMA, JAPAN
DECEMBER 4–6, 2002

• Invited and contributed papers will be presented in the following workshops:
• LC Science and Technologies • AMLCDs • FPD Materials & Components • CRTs • Plasma Displays • EL Displays • FEDs • Large-Area and Projection Displays • 3-D Display Technologies

19 FEBRUARY 03

3rd International Display Manufacturing Conference & Exhibition (IDMC '03)

TAIPEI, TAIWAN
FEBRUARY 19–21, 2003

• An international gathering of display scientists, engineers, manufacturers, marketers, integrators, users, analysts, consultants, and investors, where all aspects of display manufacturing will be discussed.
• Sponsored by the Korea Chapter of the Society for Information Display.

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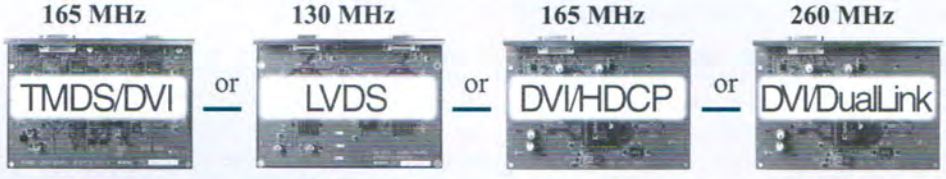

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continued from page 2

images looked nice and clean, as they should for an MSRP of $13,999.

Despite its German-sounding name, ***AG Neovo*** is a Taiwanese company. It has been establishing itself in Europe over the past 3 years, company representatives said, and it is now among the top 10 of European LCD-monitor suppliers. Some of the monitors on display were more highly designed than the typical run of monitors. In the company's premium line, a glass sheet over the monitor screen protects the display, provides anti-reflection, and has color filters that only pass the RGB peaks, which results in greater color purity, the reps said. What I saw was not entirely consistent with what I was being told, though. A premium unit with the glass filter had much more glare than a value model without it. Colors on the premium unit were more saturated, but a smaller economy unit had subtler color gradations and better detail.

NEC/Mitsubishi was showing a good-looking prototype 30-in. 1280 × 768 LCD monitor for public-information applications that uses an LG.Philips panel. The luminance was 450 nits and the contrast ratio was listed as 350:1 on the accompanying poster but as 450:1 on the data sheet. Take your pick. Commercial availability is scheduled for October/November.

Among its other displays, NEC/Mitsubishi, like Samsung, was showing CRT monitors with multi-level luminance. The luminance was enhanced up to a factor of two in three levels. In a 22-in. version, the normal luminance of 80–90 nits could be enhanced up to about 160 nits. The enhancement ratio is somewhat less if the screen has high average brightness.

ViewSonic was showing 22.2-in. 9.2-Mpixel monitor (3840 × 2400) that could only have been based on IBM's "Bertha" panel, now made by IDTech – the joint venture formed last year by Chi Mei and IBM Japan to take over the ownership and operation of IBM's LCD-manufacturing plant in Yasu, Japan.

Sony was introducing a nicely styled "X Series" of LCD monitors with a power-saver mode that is implemented by pushing a single button. And many of the varied products with a Sony label had a Memory Stick™ slot.

Lexmark had a large booth, but the product that caught my attention was the new PrinTrio X75, a combination flat-bed scanner, ink-jet printer, and copier in a remarkably svelte package for $149 MSRP. Information Display contributing editor Alfred Poor will be evaluating the PrinTrio for PC Magazine in an upcoming issue.

And, although it has nothing to do with displays, ***MediaFour*** deserves to be acknowledged in the clever software department for its XPlay™, an application that allows one to plug the popular Apple iPod™ into a Windows™ computer. In fact, XPlay makes the iPod appear as a normal hard drive in Windows Explorer, so it can be used for data files as well as MP3 files. And the iPod always remains compatible with Mac®OS, as well as with Windows, MediaFour says.

ShowStoppers

An interesting adjunct to PC Expo was "ShowStoppers," a Wednesday-evening for-the-press-only event at which selected companies get quality time with writers and editors, and the editors get good food and free drinks. "ShowStoppers" is an independently run off-site event, and most of the participating companies were only at "ShowStoppers" and not to be found at PC Expo itself. I went to ShowStoppers primarily to talk to Brian Carskadon of InFocus Corp., which was part of PC Expo last year but this year appeared only at ShowStoppers.

Carskadon, InFocus's Senior Product Manager for the LS110, the company's first projector designed for the consumer and home-entertainment market – rather than the business and professional market the company has long dominated – said the product had an extremely successful introduction at CES in January, and has since become the second best-selling home-theater projector.

The LS110 was impressive at CES, and it was also impressive at ShowStoppers, where the ambient illumination was higher.

Logitech was showing a sleek and interesting input device, the Cordless Presenter™, which, with the flip of a switch acts either as a cordless optical mouse or as a hand-held cordless device for controlling a digital slide show. What makes the Cordless Presenter particularly interesting is that the cordless part is implemented *via* a Bluetooth radio link. The device comes with a USB "mini-receiver" that plugs into an available USB port on the PC.

Belkin showed their very tidy collapsing and interlocking G700 keyboard for Palm and Sony Clié PDAs (see photo). The keyboard's collapsing action is reminiscent of that in the old IBM Thinkpad 701C "butterfly" notebook PC. When expanded to its full 9.6-in. width, the keyboard, which was developed with Benq, has a rather generous horizontal key pitch of 17 mm, compared with 19 mm for a full-sized desktop keyboard. When collapsed into itself to make what looks something like a squared-off woman's compact, the keyboard measures 3.75 × 5.625 × 0.625 in. and weighs 7 ounces.

Next Year

Next year, PC Expo's traditional time slot at the Javits Convention Center will be taken over by the first CeBIT America show, a satellite of the huge CeBIT IT trade fair held annually in Hannover, Germany, in March (and which is covered by *Information Display*

each year thanks to the efforts of contributing editor Bryan Norris and his associates). CeBIT America will take place June 18–20, 2003, and the organizers expect 425 exhibitors and 45,000 attendees. We intend to cover the event. PC Expo will be held September 16–18, 2003. ■

— KIW

We welcome your comments and suggestions. You can reach me by e-mail at kwerner@nutmegconsultants.com, by fax at 203/855-9769, or by phone at 203/853-7069. The contents of upcoming issues of *ID* are available on the *ID* page at the SID Web site (http://www.sid. org).

Please send new product releases or news items to Information Display, c/o Palisades Convention Management, 411 Lafayette Street, 2nd Floor, New York, NY 10003.

backlight

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in desktop real estate from the changeover to an FPD was extraordinary, and one other huge advantage demonstrated itself. With my (relatively) small CRT, I worked about 18 in. in front of the screen, hunched forward like some medieval scrivener. With the (relatively) big LCD, I started sitting at about 30 in. from the screen, kicked back in my chair like a free man.

So far, Venus and Mars have only made one foray into consumer-electronics land. Like the SID exhibition, the store was an FPD feast for the eyes – but with significant differences. These were all real-world products in the mass-market channel, with none of the prototypes and latest-greatest models that show up at SID. And store aisles are organized differently from exhibition aisles. All the competing displays of roughly the same size are grouped together: the cellular-phone displays in one aisle, PDA displays in another aisle, and so forth, which makes side-by-side comparisons much easier.

So far, the current quest for an LCD monitor goes well. Our single foray was enough to demonstrate that some very nice products are available at very attractive prices about two-thirds below what they were when I bought my monitor three or four years ago. The stars of the store were Apple's wide-format "Studio" LCD monitors in a nice range of sizes. Unfortunately, these monitors have a captive digital interface and only work with certain high-end Apple machines. All the other LCD monitors had analog interfaces. A few had noisy images and a few were much too dim, but the majority performed well.

The success of the first foray notwithstanding, Venus and Mars will be going to half a dozen other stores and asking the same questions of innumerable sales people (some of whom are very well-educated about the technology and some who don't have a clue).

Meanwhile, back at the desk, Mars has a display quandary. Why am I chained to my desk? Why can't I work outside? The answer, of course, is that my screen washes out in outdoor lighting, and that the screens that are bright enough are too much of a drain on battery power. Perhaps the answer lies in sourcing power for the screen from the ambient light, in applying some clever film to the display, or in the user donning an innovative pair of glasses. Where is the practical, affordable FPD technology that will really make me free? ■

David Lieberman is a veteran display journalist living in Massachusetts.

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perhaps more practical, bent to modify them into something that we find truly useful.

One recent early effort may the dynamically balanced battery-powered two-wheeled personal transportation vehicle. To me it looks like an impractical version of an electric scooter. Wouldn't it be more efficient use of sidewalk space to have the wheels in line rather than side by side? But with all the attention this new idea is creating, perhaps some of the broader concepts for personal transportation are now more likely to be explored. Therefore, while the well-developed technologies are meeting our current needs, the new and highly innovative ideas that stretch our thinking and attempt to modify our conventional ways of doing things are tremendously valuable for stimulating the future progress of technology development.

As you read this, it will have been a few short months since this year's SID International Symposium in Boston. By all of the typical measures, such as technical-session and seminar attendance, and exhibitor participation, the conference and exhibition were both major successes. The trade press has also been uniformly complimentary of our efforts. The Symposium is now generally recognized as the one event each year at which attendees can get the most complete overview of the latest developments in display technologies, as well as the most accurate look into what the future may hold.

The display industry is currently undergoing a major transition from a CRT-dominated world to one in which flat panels are becoming the displays of choice in more and more applications. While the CRT is far from obsolete and may in fact still have some surprising new developments to offer (such as the new beam indexing technique proposed by LG.Philips researchers in a paper presented in Boston), LCDs are growing in size, performance capability, and popularity. Plasma panels are making major progress by reducing manufacturing cost while also increasing brightness and efficiency. Virtually all of the displays on the exhibition floor were of a quality that I would be happy to use or have in my home. From a sales-revenue perspective, CRTs and LCDs are, by a large margin, the dominant display technologies. But plasma panels are expected to increase their penetration into the commercial-usage and television markets. A development that was unexpected just a few years ago is the possible competition that could develop between plasma panels and LCDs. The availability of a 40-in. LCD from Samsung and their plans for even larger sizes introduces a new market dynamic that will be very interesting to watch over the next few years.

The brightest stars shining in the display-technology sky are currently found in the new OLED constellation. There are a few technical challenges still to be worked out, but the rate of progress indicates that useful products will be introduced at an ever-increasing rate. If I were to select the one performance feature that will give OLEDs their starring-role quality, I would choose efficiency. The viewability of an emissive image is a further plus, and since only those pixels that are in the on-state consume energy, the resulting displays can be both bright and efficient.

Should we wish to observe yet other newly evolving display constellations and stars, we might want to pay close attention to what is happening with projection technologies. The quest for bigger and brighter viewing surfaces is becoming a stimulant for the development of new projection systems and for the exploration of other ways for putting large high-quality images in front of viewers. Projection technologies for professional applications and for consumer television will continue to provide the market drive, while the higher cost of large-screen direct-view displays will give projection-display product developers the needed incentive to strive for further image-quality improvements.

Over this last year, we have witnessed the failure of a number of companies attempting to introduce new display technologies. Furthermore, a few of the survivors are still not as stable and financially healthy as we would like them to be. An unfortunate outcome of this could be that funding for new display concepts might become harder to get. If that happens, it will be detrimental to the long-term vitality of the entire display industry. If private or institutional investment becomes scarce, it may become desirable for the large display manufacturers to step in and invest in a certain level of start-up activity to supplement the developments occurring in their own laboratories. The climate of a start-up is sufficiently different from that of a corporate research laboratory that having such dedicated and focused efforts can stimulate the evolution of new ideas. The continuation of these high-risk, but also potentially high-reward, activities is an important method for creating future successes. We must encourage innovation in the many forms it can take. The ideas that today may seem too wild for realistic product implementation may be the very ones that get us started on new paths of exploration. Finally, we must pay special attention to research on new display materials, for this is, after all, the fount of all new display technologies.

Should you wish to share your thoughts on the future of display technologies, or on any of the other topics addressed in this column, you may reach me by e-mail at silzars@attglobal.net, by phone at 425/557-8850, by fax at 425/557-8983, or by sending a letter to me at 22513 S.E. 47th Place, Sammamish, WA 98075. ■

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Back from the Candy Store

by David Lieberman

The exhibition of the annual SID International Symposium always makes me feel like a kid in an enormous candy store, strolling past rows and rows of goodies on the show floor, ogling the delights. Among the things that caught my eye at SID were these.

- A handful of display companies at May's SID Symposium demonstrated 3-D displays. Typically using an alternating right-eye, left-eye image to give the impression of 3-D, they were, without exception, unimpressive. Standing out from the crowd was a dual-LCD system from Deep Video Imaging that superimposes one LCD image on top of another and gives the impression of true depth.
- There is a lot of excitement these days over so-called bistable "electronic paper" displays, and Nemoptic unveiled a new technology at SID that achieves bistability using conventional TN-LCD materials. The trick lies in weakly anchoring LCD molecules to one glass substrate to achieve two stable states.
- The first Philips Electronics product with a built-in OLED was demonstrated at SID, but many attendees questioned the utility of the application. It's a rechargeable electric razor with a monochrome OLED in the handle. It reads out remaining battery time.
- One unquestionable SID star was the 40-in. wide-XGA LCD shown by Samsung Semiconductor, a 1280 × 768-pixel HDTV display with a 15:9 aspect ratio, a luminance of 500 nits, and a contrast ratio of 600:1. The prototype shown has visible seams. ("We don't yet have a big enough stepper," said a company representative.) Seamless versions are expected to become available in the first half of 2003, with price tags in the $5000 range.
- Kudos to Samsung Digital for its SID exhibit of seven side-by-side large-screen TV monitors representing three competing technologies: rear-projection DLP (43 and 50 in.), direct-view LCD (40 in.), and direct-view PDP (42, 50, and 63 in.).

Mars Returns to Reality – Sort Of

Now that the show is over and a few days have passed, it's time to mull things over, hit the desk, get to work, and crank out some words. That's a difficult thing to do with visions of sugarplum FPDs dancing in one's head and a gorgeous New England spring day beckoning outside.

But my return to reality was cushioned when I returned home from the show and I found out that I was going to be blessed with the opportunity to extend my FPD ogle, this time in the Circuit City's and CompUSA's of the great Northeast. My wife, it seems, has decided to buy an LCD monitor and we were going shopping. Shopping, of course, is one of those Mars/Venus things – most men deplore it, most women adore it – but for me, shopping for FPDs is a different story altogether.

I should mention that I am a big LCD-monitor booster, having traded in my 15-in. CRT for an 18-in. AMLCD several years ago. As expected, the savings

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