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Market Trends for Flat Panel Displays

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the Fox and Li formalism [5]. The two mirrors depicted in figure 1 were assumed to be perfectly reflecting and infinite in extent as compared to the pixel width. The pixels were modelled as infinitely thin slits, placed in the resonator in accordance with our experimental geometry. The resonator is modelled as an infinite progression of slit apertures, with a length between apertures alternating between twice the distance from the PDLC to the dichroic mirror, and twice the distance to the output coupling mirror. Because the flat high Fresnel number geometry violates the small-angle approximation, the complete integral of the Fresnel diffraction kernel was used in the simulations.

A variety of simulations were performed for a simple 8-pixel array. The numerical experiments varied the resonator lengths, pixel widths, and pixel separation in order to find the regime of resonator conditions where the system would emit an image mode which was a replica of the internal loss pattern. Defining a pixelation Fresnel number, $N_F = ab/2\lambda L$, where a is the pixel width, b the pixel separation, and L is the distance from the PDLC to the most distant mirror, we were able to show that this quantity had to be of the order of $N_F \geq 2$ to produce image modes. Figure 4 shows how the mode confinement in an 8-pixel array breaks

down as N_F decreases. Confining the mode is an important requirement for producing the desired image as well as preventing the off-state area from damage due to a high optical field.

The future

Lasing PDLC pixel arrays look very promising for a new generation of advanced projection systems. We are currently moving from laboratory passively driven prototypes to high resolution active matrix substrates and drive schemes. In addition we are developing novel optical configurations for the proliferation of full-colour using the third harmonic of a Nd:YAG laser as a pump source. Based on our demonstration of this concept, with 355 nm pumping of other blue and green emitting laser dyes such as the coumarins and stilbenes, we believe that a single pump laser system based on a long-life diode pumped Nd:YAG laser is quite feasible. Figure 5 shows a schematic of such a configuration. In order to achieve the greatest possible image colour palette, the RGB components must be chosen near the three corners of the chromaticity diagram by a proper choice of the organic dyes and dichroic mirrors in the individual systems.

Experiments are also in progress to integrate the gain into the PDLC light

valve so that the dye cell and mirrors can be removed and scattering is used to provide the requisite feedback for laser action [6, 7]. More technical details on the lasing PDLC pixels will appear in the literature [8].

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COMPANY AND MARKET NEWS

A recent report from Stanford Resources entitled 'Flat Panel Monitor Market Trends 1998' presents a realistic forecast for the FPD market, which is expected to reach a shipment value of \$4 billion in the year 2000. The Flat Panel Display market covers active matrix twisted nematic displays (TFT-LCD) and matrix-addressed super-twisted nematic displays (STN-LCD), and the following are highlights from the market analysis and forecasts.

- The world market for FPD monitors will reach 21.7 million units in 2004, rising from 729,000 units in 1998, and the overall market penetration of the desktop monitor market will increase from less than 1% in 1998 to 17.3% in 2004.

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- The world-wide value of all FPD monitors (TFT-LCD and STN-LCD) will reach \$12.5 billion in 2004 increasing from \$1 billion in 1998.
- Beginning in 2000, 14 inch and 15 inch FPD monitors will dominate all other screen size categories. Sales of 14 inch monitors will surge in late 1998 and early 1999, when unit street costs fall below \$1000 in the US.

- The Japanese share of FPD production will fall from 65% in 1997 to less than 55% in 1998, as production accelerates in Taiwan, Korea and Europe.
- The total potential market for TFT-LCD monitors is more than 4.7 million units in 1998, but only 600,000 units are expected to be sold.
- By 2004, 15 inch LCD monitors at unit prices around \$500 are expected to dominate the FPD market with sales of 9.3 million units.

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