Will OLEDs Replace Small TFT-LCDs?

Some OLED proponents believe that their technology is a "disruptive" technology that will challenge TFT-LCDs in the rapidly growing market for small- and medium-sized displays. But, although OLED sales will grow appreciably, domination of TFT-LCDs is not likely.

by Barry Young

In November 2000, Dr. Alan Heeger – distinguished scholar and, at the time, a recent recipient of the Nobel Prize in Chemistry – announced to the world at Intertech's OLED 2000 conference in San Diego that organic light-emitting-diode (OLED) displays were a "disruptive" technology that would replace LCDs as the dominant display technology in the next 10 years. Uniax, the company Heeger had founded to develop polymer-OLED (PLED) technology, had recently been purchased by DuPont. DuPont announced that it would marshal its mighty corporate resources in support of that technology, but it had little or no expertise in OLEDs and was using Heeger's Uniax as a jumping-off point.

Heeger pointed to the OLED's thin form factor, low power consumption, wide color gamut, high contrast ratio, wide viewing angle, fast response time, and low-temperature manufacturing process compared to those of thin-film-transistor liquid-crystal-displays (TFT-LCDs), and claimed these obvious advantages as evidence for his "disruptive" claim. He put the OLED *vs.* TFT-LCD comparison in a class with integrated circuits *vs.* vacuum tubes, automobiles *vs.* the horse or bicycle, and LCDs *vs.* CRTs. At the time, this author took the outrageous position of challenging the Nobel Prize winner, not by refuting the prediction that OLEDs would be successful, but by disagreeing with the position that OLEDs would be truly "disruptive."

Today, even as we enter the inevitable downturn portion of the crystal cycle, TFT-LCDs are perhaps the healthiest and fastest-growing high-technology industry in the world. In 2004, year-to-year unit sales were up 43%, revenues were up 45%, display glass was up 48%, and we expect continued growth in the next 5 years as TFT-LCDs completely dominate the huge information-technology (IT) market and target the even-larger TV market. A very short 4 years have gone by and it is really too soon to judge the outcome. But there are a number of signs indicating that OLEDs are not "disruptive," but represent, at

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Table 1: Comparison of OLED *vs.* TFT-LCD Performance Characteristics

	Status		Forecast
	2000	2004	2010
Thin form factor	+++++	++++	+++++
Wide color gamut	+++	++	=
Low power consumption	−−−	−	+
High contrast ratio	+++++	+++++	+++++
Wide viewing angle	+++++	+++	++
Fast response time	+++++	++++	++
Low-temperature manufacturing process for flexible substrates	P	P	+++
Manufacturing cost	−−−−−	−−−−	+
Imaging sticking	−−−−−	−−−	−
Differential aging	−−−−−	−−−−−	−
Short material lifetime	−−−−−	−−−	=
Highly reflective surfaces	−−−	−−	−
Low efficiency material and relatively low external quantum efficiency	−−−−−	−−−	=

Legend: +, Better; +++++, Significant competitive advantage; P, Promise (not yet practical); =, No competitive advantage; −, Worse; −−−−−, Competitive disadvantage.

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