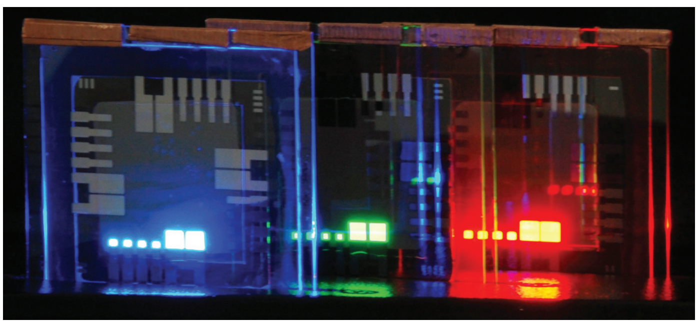
update

Quantum Dots Are Behind New Displays

They make LCDs brighter and could challenge OLEDs for future TV dominance



BRIGHT DOTS: QD Vision is creating a display from quantum-dot LEDs.
PHOTO: QD VISION

LIQUID CRYSTAL displays dominate today's big, bright world of color TVs. LCDs are inefficient, though, and don't produce the vibrant, richly hued images of organic light-emitting diode (OLED) screens, which are expensive to make in large sizes.

But a handful of start-up companies have been plugging away at another display technology that could enhance LCDs and maybe unseat OLEDs: quantum dots. These light-emitting semiconductor nanocrystals shine pure colors when excited by electric current or light and promise rich, beautiful displays that would be inexpensive and easy to manufacture.

In June, quantum-dot developer Nanosys announced that it was working with 3M to commercialize a quantum-dot film that could be integrated into the back of ordinary LCD panels. The film could cut the display's power consumption by half and enable LCDs to generate 50 percent more colors within the range set by the National Television System Committee. Nanosys's CEO, Jason Hartlove, says that major LCD manufacturers are now testing the film, and a 17-inch notebook computer incorporating the technology should be on shelves within six months.

"We've designed this technology to give LCD manufacturers a competitive counterweight to OLEDs," he says. "[It] drops in and is compatible with existing LCD manufacturing methods."

New LCD TVs typically have a strip of white LED backlights along the panel's edge. Light guides spread the illumination evenly across the panel; the light then passes through a series of optical films that colorize, polarize, and diffuse it. The resulting red, green, and blue hues are mixed at different intensities to produce the

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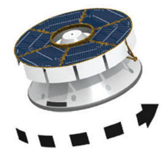
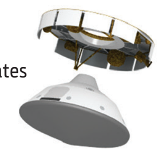


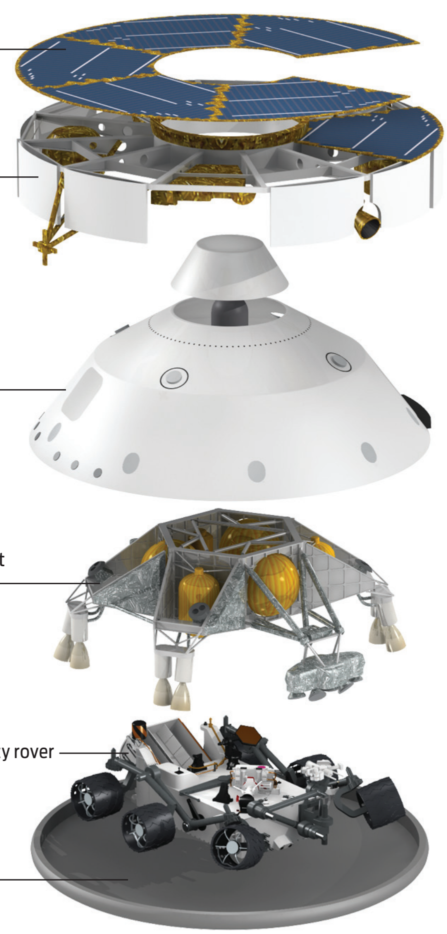
1. About 20 minutes from landing and spinning at 2 revolutions per minute, the spacecraft takes one last fix on the sun and stars for orientation.



2. The cruise stage separates about 1500 kilometers above the surface, 17 minutes from landing.

3. Thrusters are fired to stop the robot's rotation. Two 75-kilogram tungsten masses are ejected from one side of the spacecraft. Once the craft is in the atmosphere, the resulting offset in its center of mass will create a 20-degree angle of attack, providing lift.

NASA Mars Science Laboratory Spacecraft



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Continued from page 14 display's color spectrum. But with today's technology, "the broad-spectrum white has a bunch of pinks, yellows, and oranges," Hartlove says. "So when you create a red from a color filter, you let in a bunch of different reddish colors."

Nanosys's quantum-dot film converts some of the light from highly efficient blue LEDs to spectrally pure red and green, resulting in a broad color gamut and more-lifelike images.

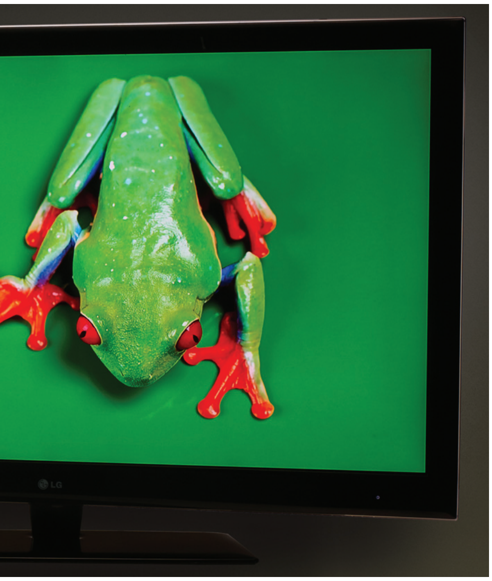
QD Vision, based in Lexington, Mass., is developing its own LCD backlight technology, which literally and figuratively has an edge over Nanosys's, says CTO Seth Coe-Sullivan. Instead of using a large film of quantum dots, its product would integrate the quantum dots into the LED array on the panel's edge. "So we use 1/100 of the material, which is not inexpensive," he says. That advance required engineering dots that could operate efficiently at the higher temperatures at the backlights.

QD Vision is also working on a quantum-dot-based display that emits light, the way OLED displays work, rather than transmitting it as LCDs do. OLED pixels contain a thin layer of light-emitting organic semiconductor sandwiched between two electrodes. QD Vision swaps quantum dots for the organic material.

Quantum dots can easily be suspended in solvents to make inks that can be stamped or printed without losing their glowing prowess, so the displays should be cheap to make. What's more, quantum dots are also intrinsically more efficient than organic semiconductors.

QD Vision demonstrated a 4-inch-diagonal prototype of the display last year, and the company has since teamed up with LG Display to commercialize the technology. Samsung, meanwhile, is also pursuing quantum-dot LED displays. Last year, researchers at the Samsung Advanced Institute of Technology reported 4-inch-diagonal color displays made on glass and plastic.

Quantum dots, both in LCD backlight films and as light emitters, might still find OLEDs to be tough competition. OLED displays have been relegated to small screens, but this year LG and Samsung unveiled the first 55-inch OLED TV prototypes. Samsung claims that it will launch a commercial version later in 2012 in South Korea, though at a price of US $9000—or 10 times as expensive



BRIGHT IDEA: The 47-inch HDTV on the right has been modified with Nanosys's quantum-dot film to enhance the performance of its backlight.
PHOTO: NANOSYS

as LCD sets—but the cost should drop as the technology improves. "There [have] been decades of work on organic emissive material, and there have been a lot of improvements," says Paul Semenza, a senior analyst at research firm DisplaySearch. "It's not like quantum dots are competing against a new thing."

Semenza says that the success of quantum-dot display technology will depend in part on developments in OLEDs and LEDs over the next few years. The LCD backlight approach shows promise because it's easy and shows visible improvements, but "as white LED backlights improve, the benefit from doing this might diminish," he says. OLEDs, meanwhile, are already beautiful but costly to manufacture. "If quantum-dot displays are easy to manufacture [and] have a lower cost process and better efficiency, they could be big." —PRACHI PATEL

A version of this article appeared online in June 2012.