THE Ames Laboratory
Creating Materials & Energy Solutions

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How light can keep us safe

Scientists at the Ames Laboratory prove that a new display technology could be used to make sensors which can protect the world from terrorism and other threats

Plasma, liquid crystal displays (LCDs), and light-emitting diodes (LEDs): As most people know, these are the technologies we use today to make flat-screen TVs. But a newer technology, known as organic light-emitting diodes, or OLEDs for short, might someday become the most common display medium of all.

Two things make OLEDs outshine their competition. The first is power consumption. OLEDS require a lot less electricity to glow brightly on their own. LCDs, by contrast, require that a power-hungry light source be placed behind them, acting like a projector, in order for the images to be seen. OLEDs will also cost far less than other display technologies – and for an equally simple reason. They can be easily mass produced. In fact, OLEDs will eventually cost so little to make that one day we might see them in magazines. Imagine yourself watching different moving TV-like images on newspaper pages just like in Harry Potter films. And that's not all OLEDs might be used for. Someday they might make the walls in our homes change color at the twist of a dial or create different patterns on your athletic shoes, depending on how fast you run.

A blanket of protection

Scientists at the U.S. Department of Energy's Ames Laboratory believe that in addition to these cool products, OLEDs might also be used in sensing devices. That is, devices capable of detecting dangerous chemicals or harmful viruses.

Joseph Shinar, a senior physicist at the Ames Laboratory and Ruth Shinar, a senior scientist at Iowa State University's Microelectronics Research Center, have been working with OLEDs for many years. Recently, the two created prototypes of OLED-based sensors. The Shinars'

OLEDs use less power and cost less to make than other displays.

OLEDs' ability to emit light brightly could make them ideal for TVs.

WHAT'S SO 'ORGANIC' ABOUT ORGANIC LIGHT EMITTING DIODES?

OLEDs are made of thin films of large (polymers) or small organic molecules; such molecules contain the elements carbon and hydrogen. Carbon is found within all living organisms. Of course, so-called hydrocarbons are also found in many non-living things – OLEDs, for example. So the organic materials used for making OLEDs are the reason we add the term organic to OLEDs. The light-emitting diodes (LEDs) used in some of the newest TVs contain no hydrocarbons, so there's no reason to add an 'O' at the start of their name.

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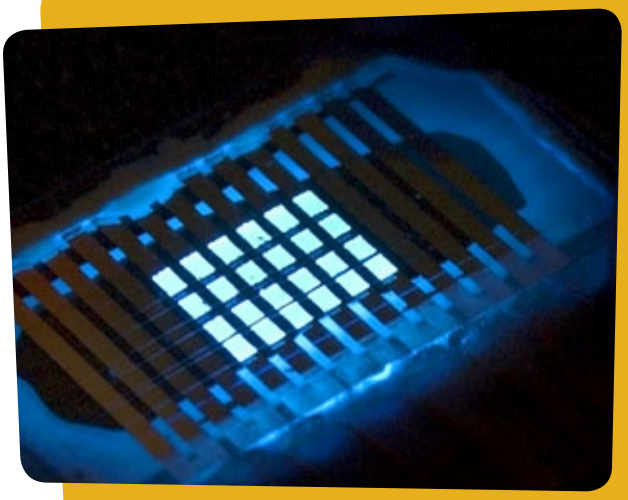


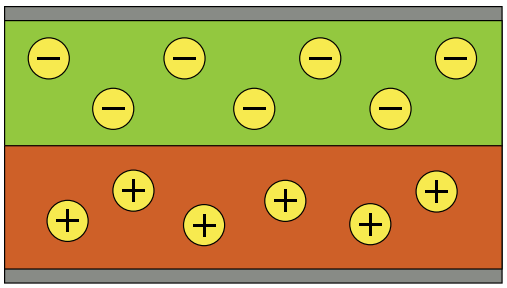
Future uses of OLEDs include flexible displays, sensors, and even clothing that changes color.

HOW AMES LAB SCIENTISTS MAKE THEIR OLED SENSORS WORK

- A substance being tested comes in contact with a thin film above the OLED. The film contains a material that reacts in some way when it comes in contact with the test substance.
- The OLED, powered by a small battery, provides a light source. In the presence of light, the reacting substance will itself glow a certain color. This glow changes when it is exposed to the test substance.
- A light-sensitive detector records the changes in the glow when they occur.
- The detector triggers an alarm or transmits the information to a computer.

experiments show that OLED sensors are as good or better at detecting dangers as other sensors currently being used, while costing far less.

Ames Lab researchers are already looking at ways to design OLED-based sensors that can test for many substances at once. The Shinars say that sensors, each testing for a separate substance, could be placed on an OLED array, where each element in the array is about one millimeter square, or roughly the size of a pinhead. Someday, thousands of sensors might be placed in airports, train stations, and other areas where many people gather. Each of the sensors could transmit an alarm to a computer, which would determine the nature of the threat.



A cross-sectional view of an OLED

HOW TO MANUFACTURE OLEDS

A large number of OLEDs pixels used to make sensory devices can be manufactured at one time, using a process known as thermal vacuum evaporation.

- The organic materials that will form the OLEDs are heated until they turn into vapor.
- The vapor is in a chamber that's kept at a low pressure to reduce contamination.
- The vapor condenses on top of a material, forming a thin film.
- Using special designs enables formation of an array of individual small-size OLEDs.