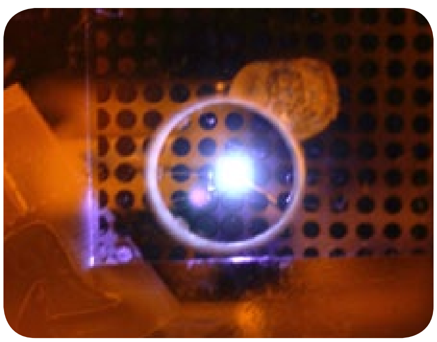
THE Ames Laboratory
Creating Materials & Energy Solutions

# Low-Cost OLED Sensors for 24/7 Protection

***A tiny Ames Lab invention could create an elaborate web, safeguarding us against viruses, toxic chemicals, and terrorist threats***

While much of the commercial research in the area of luminescent technologies has focused on large, high-resolution display media for home entertainment, many other important applications exist. Light emitting diodes (LEDs), for example, the basis for the newest generation of HD TVs, are available for lighting in homes and workplaces.



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

Meanwhile, a related technology called organic light emitting diodes (OLEDs), which has been greatly advanced by research at the U.S. Department of Energy's Ames Laboratory, has also shown great promise. OLED displays can already be found in cell phones and MP3 players and other products.

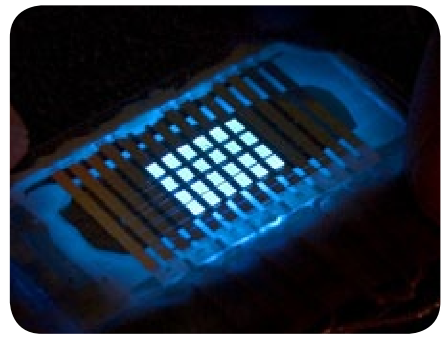
OLEDs consist of carbon-based thin films. Their carbon content leads us to use the term organic. The films are sandwiched between electrodes.

Under an electrical bias, the OLED pixels begin to glow. Ames Laboratory senior physicist Joseph Shinar and Ruth Shinar, a senior scientist at Iowa State University's Microelectronics Research Center, believe OLEDs will soon play an important role as sensing devices.

OLED-based sensing platforms are capable of detecting substances ranging from viruses to toxic chemicals with levels of sensitivity equaling or exceeding the performance of established sensor technologies.

Moreover, the OLED platform possesses additional key advantages over other sensing devices: compact and flexible size and design, suitability for substrates such as glass and plastic, ease of structural integration with sensing components and photodetectors, the ability to create array structures for simultaneous sensing of multiple analytes, low power consumption, as well as low cost.

Indeed, significant cost savings result from OLEDs' simplicity in design and manufacture. Sensors currently on the market often possess relatively complex structures. Some employ expensive lasers or other light sources that require careful assembly.



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

OLEDs, by contrast, can be mass produced as an array of individually addressable pixels, using established processes such as spin coating or thermal vacuum evaporation.

In the latter, the OLED's organic materials are heated until they evaporate. Then, under low pressures, they're allowed to condense and form a thin film atop a substrate. The result is an array of tens of individual small-size light sources suitable for sensing applications that can be made in a single production run. This would greatly reduce their manufacturing costs to

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

## HOW AMES LAB SCIENTISTS MAKE THEIR OLED SENSORS WORK

- The substance the OLED-based sensor is designed to detect comes in contact with a thin sensing film whose luminescence (excited by the OLED) is sensitive to the substance of interest. The sensing film has been chemically designed to react when contact with the potentially threatening substance occurs.
- The OLED, powered by a small battery, provides a light source. In the presence of light, the sensing material will itself luminesce, emitting a specific color, which is affected by the target substance.
- A photodetector records the luminescence and transmits the information to the control, processing, and display unit.

the extent that OLED sensors might someday become single-use, disposable products. OLEDs' advantages of low energy consumption and low cost mean that numerous sensing devices could be deployed within large public areas, or even homes, creating a comprehensive blanket of protection.

Ames Lab researchers have begun looking at more complex sensors that incorporate an array of different sensors, enabling them to detect multiple substances at once. When perfected, these devices would be similar to a lab on a chip. The Shinars' current research suggests that adjacent sensors that test for a separate substance, could be placed on an OLED platform with pixels that are each less than one millimeter square.