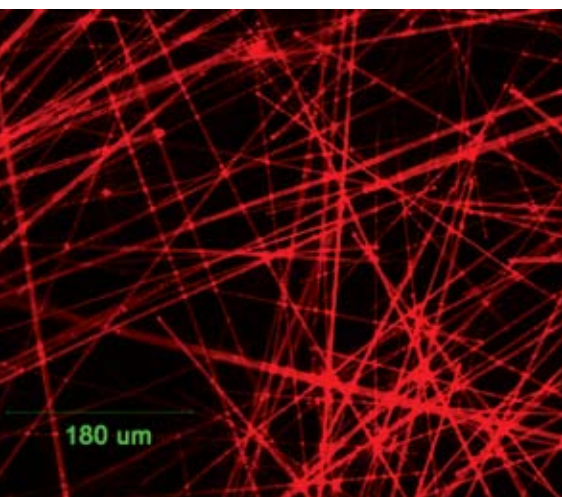


A Trace of Danger

SMALL-SCALE SENSOR TECHNOLOGY FOR BOMB DETECTION



LEFT TO RIGHT:

- Fluorescent glowing nanofibers used in optoelectronic nanodevices. Each strand is about one-fifth the size of a human hair.
- Used for explosives detection, the net of super-fine nanofibers are so tiny, the diameter of one fiber can be measured in terms of merely a few atoms.

Since the beginning of the Iraq War in 2003, nearly 60 percent of attacks against U.S. soldiers have begun with a homemade bomb, also known as an IED (Improvised Explosive Device). IEDs are widely used by insurgents to attack soldiers. They may be buried in the ground as roadside bombs or landmines, or used by suicide bombers.

“Our forces on the frontline in Iraq and Afghanistan need to be able to see the danger [from explosives] before it’s too late,” says Ling Zang, USTAR associate professor of materials science and engineering. USTAR stands for Utah Science Technology and Research, a legislative initiative to strengthen technological research and stimulate economic development in the state of Utah. Zang came to the University of Utah last fall from Southern Illinois University Carbondale, where he was associate professor of chemistry and biochemistry.

Electronic sensors — like the ones used in airports and other security checkpoints — detect explosives made with TNT (trinitrotoluene), but these sensors are expensive, not portable for soldiers on the go, and lack sensitivity to detect homemade chemicals used in IED explosives.

“The best sensor would detect even trace amounts of explosives from a long distance,” says Zang. “It needs to be very sensitive, but also must be selective to minimize false alarms.”

NANOWIRE SENSORS

Zang and his associates have developed and patented a portable sensor device that identifies the presence of TNT from many yards away. The sensor includes strands of fluorescent nanowires

— infinitesimally small threads that act as super-fine filters — to catch molecules from explosives as they float through the air.

“These tiny nanowires are intertwined like a spider web,” says Zang. “The threads capture single molecules from an explosive just like a web catches flies.”

When TNT molecules are captured, the glowing nanowires go extremely dim. The decrease in fluorescent emission is used as the sensing transduction signal. Zang’s group plans to combine an optical component with the electronic sensor to develop a dual-mode sensor that would provide unprecedented sensitivity and increased reliability (to minimize false positives) in explosives detection. The improved device will be used as long-distance standoff bomb detectors, minimizing the risk to soldiers and bomb squads. The Department of Homeland Security (DHS) and National Science Foundation are currently funding the research. More support for the sensor project is expected from the U.S. Army and the Department of Defense.

“The DHS requires the distance for detecting explosives to be from at least 50 meters away,” says Zang.

COLORIMETRIC SENSORS

The government is also supporting one of Zang’s projects to develop a special sensor for IEDs, which are not easily detected by traditional electronic sensors. The colorimetric sensor comprises highly porous, colorless material that turns bright yellow when a homemade explosive is detected.

“The colorimetric sensor is cheap, portable and easy to use,” says Zang. “But as with the dual-mode sensor, we are working on improving its sensitivity.”

Clean and Renewable: Harnessing the Sun's Energy

Arguably one of the great challenges facing society is the development of renewable energy sources. The supply of expendable resources, such as fossil fuels, is dwindling while the global demand for energy is growing.

Because it is abundant and renewable, solar energy may provide a significant contribution to the world's energy needs. One of the more promising ways to harness the sun's energy is through solar cells, which convert

energy from the sun directly into electricity. For more than a decade Ling Zang, associate professor of materials science and engineering, has been developing solar cell technology.

Most solar cells on the market are made from silicon, but the excessive cost makes widespread use prohibitive.

"Silicon solar cells work well, but they are very expensive," says Zang. "That's why we can't just put them on our roofs to power our homes."

Zang and his associates are designing solar cells with nanocomposites—new nanotechnology materials made from organic compounds. These flexible, energy-generating materials are coat-able, so they can be painted onto roofs, walls, or cars, whatever needs powering.

"We're trying to make the material more efficient and cost-effective," says Zang. "In the long-term, solar energy will be at least part of the solution to the energy issue."

Ling Zang

