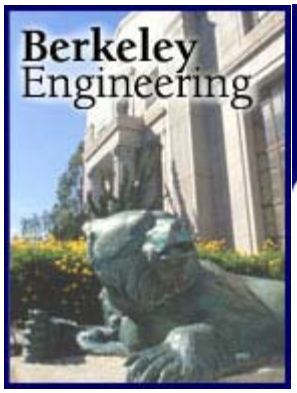

Lab Notes

Research from the College of Engineering, University of California, Berkeley

SMART DUST SNIFFERS

by David Pescovitz

In 1991, Richard White sadly watched as homes in the Berkeley and Oakland hills burned in a massive fire. Now, the professor in the Department of Electrical Engineering and Computer Sciences is developing technology to help protect the firefighters that risked their lives to protect White and his neighbors.

Richard White (on right).
Photo courtesy Richard White

White is designing chemical sensors that firefighters could wear to warn them when deadly carbon monoxide is in the air. The inexpensive devices are based on the Smart Dust Mote platform, matchbox-sized sensors outfitted with their own "TinyOS" operating system and wireless transceivers. The data the Motes gather hop from one Mote to another, ultimately landing at a central location for processing. Developed by UC Berkeley researchers as part of the Center for Information Technology Research In The Interest of Society (CITRIS), the Motes are commercially available from Silicon Valley-based Crossbow. Within several years, CITRIS researchers expect to shrink the Motes to a millimeter on all sides through manufacturing processes similar to those used to fabricate integrated circuits.

White burns incense to trigger the carbon monoxide sensor. *David Pescovitz photo*

White began developing the chemical sensing Smart Dust after a meeting of the Berkeley Fire Safety Commission, on which he served for eight years. He had brought a Mote to instigate discussion of potential fire-related applications with the Assistant Chief David Orth of the Berkeley Fire Department.

"We went out to his car and grabbed his firefighter helmet," White says. "The Smart Dust Mote slipped perfectly behind the badge on the front of his helmet."

In recent experiments with a prototype chemical sensor and a stick of burning incense, White and graduate student Justin Black noted that the Mote is capable of detecting carbon monoxide almost instantly and resets the moment the source of the gas is removed. Typical carbon monoxide sensors, like those available at hardware stores, take several minutes to detect the poisonous gas and more than a quarter-hour to return to a normal state after being triggered.

Along with alerting firefighters to the poisonous gas, White believes Smart Dust Motes could also help determine the safety of today's firefighting gas masks.

"It's been difficult to tell how much carbon monoxide actually seeps into masks, but the Motes are small enough to fit inside the mask and detect the leak," White says.

Most recently, White demonstrated a Mote that detects hydrogen sulfide, ideal for refineries where dozens of sensors could be installed to keep a constant vigil for hazardous leaks. One near-term testing ground for the chemical-detecting Motes is likely to be the new state-of-the-art microfabrication facility under construction on campus. White, a co-founding director of the Berkeley Sensor and Actuator Center, hopes to deploy a network of chemical sensing Motes in the fab. In most industrial chip fabs, poisonous gases like arsine, phosphine, and silane are detected with a complicated apparatus that draws air from gas storage areas past a mechanical roll of chemically-sensitive paper tape that changes color in the presence of toxins.

White's plan for the chemical-sensing Motes goes far beyond industry though. Someday, he hopes arsenic-sensing Motes could help rural villagers in developing nations ensure that their water supply is safe to drink. On a larger scale, sensor networks could enable much higher-resolution environmental monitoring at a much lower cost. For example, he says, much of the water flow and pollution data from large bodies of water is gathered by ships with on-board sensors.

"A much cheaper and better way would be to drop hundreds of chemical sensing Smart Dust Motes into the water," White says. "Then, a plane could fly back overhead and grab all the data."

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