NJIT professor obtains patent to uncover trace elements of airborne pollutants

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A breakthrough patent awarded to a New Jersey Institute of Technology (NJIT) researcher will enable manufacturers to create a device to uncover miniscule amounts of airborne pollutants. Using computer chip technology, Somenath Mitra, PhD, professor and chair of NJIT's Department of Chemistry and Environmental Sciences, has developed and patented what could eventually become a simple keychain device to detect tiny, though potentially lethal, amounts of airborne carcinogens.

Calling the invention a microconcentrator, Mitra said his NJIT research team has created a novel, cost-effective and efficient method to concentrate pollutants. By doing so, pollutants can then be introduced onto a sensor to identify trace pollutants.

"Our chip has a polymer enabling it to concentrate the pollutants and a tiny built-in heater that drives them onto the sensor," Mitra said. "It works like a bicycle pump. First our chip accumulates the pollutants as a pump fills with air. Then, the chip directs the tiny heater to send a large enough sampling of pollutants—if they exist-- to the sensor's head. With a large sample, the sensor can recognize that pollutants exist."

"A Microfabricated Microconcentrator For Sensors and Gas Chromatography," US Patent 7147695B2, was awarded to Mitra in December of 2006. Research about the invention was previously published in Sensors and Materials ("Design and Fabrication of Microheaters for Microfluidic Channels") in 2006 and The Journal of Chromatography A ("A Microfabricated Microconcentrator for Sensors

and Gas Chromatography") in 2003.

"The value of our sensing system is that it can see pollutants even when they are present at very low concentrations," said Mitra. "Down the road, we hope to see this technology pave the way for developing a small, inexpensive device to fit on a key chain. These devices would do the same job as larger instruments used in chemical laboratories for monitoring organic and other pollutants in air and water."

Although many advances have been made in science, it is still not as simple as many people imagine for scientists to monitor pollutants. The consequences from automobile exhaust, the dilution of cleaning solvents in air or the problems that occur when tankers spill gasoline, remain of concern to scientists.

"Typical concentrations of many pollutants can be small--only a few molecules of pollutants in every part per billion of air or water molecules," Mitra said. "But even at these levels, these pollutants pose a threat to human and public health."

"For example, we know that benzene, a by-product of automobile exhaust, causes cancer," Mitra said. "The organics from auto exhaust fumes also lead to smog formation in urban areas like Los Angeles. Measuring benzene and similar chemicals, though, is costly and difficult. One must have access to large instruments that cost thousands of dollars. But using the microconcentrator, this will no longer be the case."

Although the market currently features affordable miniature sensors, the technology is not there yet for the tiniest amounts of pollutants, said Mitra. "I'm talking about creating an instrument sensitive enough to measure concentrations of pollutants such as benzene, which may range in just a few parts per million or even billion."

Mitra's research interests are two-pronged. He looks for novel analytical techniques and sensors to discover low-level trace elements in air, water and soil. His current projects include developing instrumentation and methods for continuous, on-line analysis of trace levels of organic pollutants in air and water. These methods range from using gas chromatography or mass spectrometry to micro-scale, lab-on-a-chip devices.

Mitra also looks for new ways to assemble and modify carbon nanotubes to create novel and new materials to be used in applications ranging from tennis rackets to rocket ships. Other uses might include developing smaller nano chips for electronics (also known as nano-electronics) and inexpensive, high-performance throw-away chemical sensors. The latter might range from sensors for clinical diagnostic purposes to using sensors to find toxic chemicals in air, food or water.

Mitra has published 70 journal papers and is the coauthor of Environmental Chemical Analysis (CRC Press, New York, 1998). He also edited Sample Preparation Techniques in Analytical Chemistry (John Wiley, New York, 2003). Mitra holds five patents and has made more than 150 presentations conferences.

Source: New Jersey Institute of Technology