When the team injected a dilute solution containing PSA, the negatively charged protein bound to the antibody and altered the conductivity of the FET, Lieber's graduate student Wayne Wang reported at the meeting. Wang says he and his colleagues detected PSA down to levels of 0.025 picograms per milliliter, making their device the most sensitive PSA detector yet created—more than 100 times as sensitive as commercial PSA tests. A similar sensor picked up the presence of CEA, a marker for colorectal cancer, and a simple array of nanosensors detected both cancer markers simultaneously.

"They have made really beautiful progress," says Jie Liu, a chemist at Duke University in Durham, North Carolina. Nanowire sensors still have a long way to go before reaching the market, Liu says. But if they can be mass-produced at a reasonable price, they might someday be as ubiquitous as the stethoscope.

Snapshots From the Meeting

Preferred Painkiller. Morphine can be powerful medicine, but it's addictive and carries intestinal side effects. At the meeting, Robin Polt, a chemist at the University of Arizona in Tucson, reported devising a novel peptide that in animal studies appears even more potent than morphine and is less addictive. Polt's team found that linking a small sugar molecule to the peptide helped it find its way into the brain. You can expect to see similar sugars decorate other peptide-based brain drugs in the future.

Heads Up. Sure, a massive meteor impact killed off the dinosaurs 65 million years ago. But new calculations by John Birks of the University of Colorado, Boulder, suggest that smaller, more frequent meteor impacts may wipe out global ozone as often as once every 40,000 years. Look for future ice core measurements to see if paleoclimatologists can spot the expected chemical signature.

DNA Computing Twist. Conventional DNA computers are prized for their ability to solve complex tasks, such as the classic traveling salesrep problem. But they don't use conventional computer-based logic based on 1's and 0's. At the meeting, Reza Ghadiri of the Scripps Research Institute in La Jolla, California, reported creating a scheme to coax DNA molecules to work as a standard logic circuit. So far, the circuits carry out only three operations, but efforts are under way to boost their complexity.

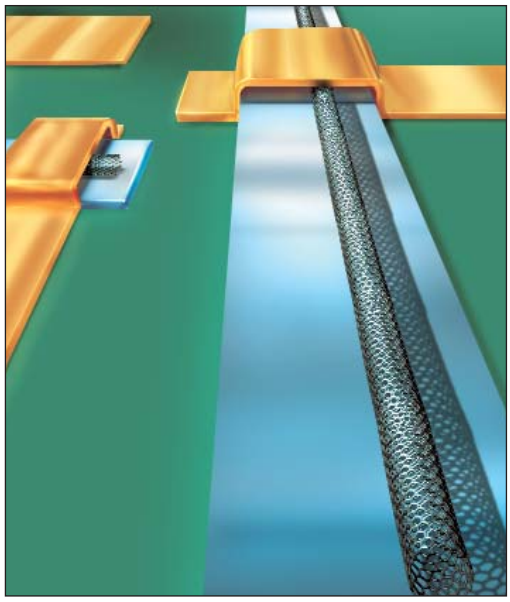
Nanomaterials Show Signs of Toxicity

Nanosized materials are often hailed for their extraordinary electronic, light-emitting, and catalytic properties. But their unique physical characteristics raise concerns that tiny clumps of metals, ceramics, and organics could prove uniquely toxic as well. In New Orleans, three groups of researchers described early efforts to test whether that is the case.

Two studies focused on single-walled carbon nanotubes (SWNTs), tiny tubes of rolled-up graphite that hold enormous promise for everything from nanoscale electronics and sensors to lightweight materials. At the moment, SWNTs are made in gram-scale batches that pose little threat to the general public. But chemistry Nobel laureate Richard Smalley of Rice University in Houston, Texas, has predicted that if a cheap, large-scale production method could be devised, SWNTs could be sold by the metric ton, undoubtedly increasing exposures.

At the meeting, groups led by Chiu-Wing Lam of NASA's Johnson Space Center in Houston and David Warheit of DuPont in Wilmington, Delaware, reported that nanotubes can damage lung tissue in mice. Lam's team exposed groups of mice to one of four substances: newly made SWNTs mixed with tiny grains of the metal catalyst used in making the nanotubes; SWNTs treated to remove the metals; carbon black—another all-carbon material shaped like amorphous globs; or nanosized quartz particles, which have well-characterized toxicity.

They then spritzed the mice's lungs with a solution containing either a moderate or large concentration (0.1 or 0.5 micrograms of material suspended in inactivated mouse serum) of the materials and left the animals alone for 7 or 90 days. Standard histological tests showed that all the particles made their way into the alveoli, the tiny air sacs in the lung, and most remained there intact even after 90 days. The carbon black particles triggered little inflammation. But even in lower concentrations, the nanotubes—with or without metal particles—triggered the formation of granulomas, a combination of dead and live tissue surrounding the material that's a significant sign of toxicity, Lam says. Warheit reported seeing granuloma formation in a similar study but noted that the inflammation seemed to tail off after 3 months. Both researchers cautioned that conclusions about nanotubes' toxicity must wait until researchers learn how the animals' lung tissue reacts to airborne particles. Such studies are likely to begin soon, Lam says.



Small concern? Carbon nanotubes could hold the key to molecular electronics but might be bad for your health.

ILLUSTRATION: C. SLAYDEN/*SCIENCE*

Nanotubes weren't the only material to raise red flags. Nanoparticles made from polytetrafluoroethylene, or PTFE, showed even more dramatic effects. Toxicologist Günter Oberdörster of the University of Rochester School of Medicine and Dentistry in New York reported that when his lab exposed rats to air containing 20-nanometer-diameter PTFE nanoparticles for 15 minutes, most of the animals died within 4 hours. By contrast, those exposed to air with PTFE particles 130 nanometers in diameter (the size of a small virus) suffered no ill effects. Oberdörster cautioned against reading too much into the comparison, as the technique for making the smaller particles could have altered them chemically, he says. But histology studies showed that macrophage cells that clear out foreign material had trouble ridding tissue of the smaller particles. In another study, Oberdörster found that inhaled carbon-13 and manganese nanoparticles reached rats' olfactory bulbs and then migrated throughout the brain.

Most researchers present cautioned that such preliminary toxicity studies don't warrant drastic action, such as regulating nanoparticles. But they agree that further work is essential. "There's issues of risk with every new technology," says Vicki Colvin, a chemist at Rice University. "It would be silly to think we have nothing to consider." Concerns about nanoparticles' toxicity must be addressed while the field is still young and exposures limited, Colvin says: "I'd much rather face this now than after nanotechology becomes widespread." **–ROBERT F. SERVICE**