Chemistry

Peptide dampens moth's sex appeal

When corn earworms mate, the males leave their partners with more than just sperm – they also transfer a substance that makes the females less eager to find other mates. This substance, called soluble pheromonostatic factor, is a basic peptide containing 57 amino acids, says Wanda M. Bodnar, a graduate student in chemistry at the University of Virginia in Charlottesville. She and her colleagues reported this result at the annual meeting of the American Society for Mass Spectrometry, held this month in Washington, D.C.

Like many moths, this agricultural pest courts via volatile chemicals called pheromones. The female releases pheromones to attract a male. Tim G. Kingan at the U.S. Department of Agriculture research center in Beltsville, Md., had isolated this factor and demonstrated that once the male passes it to the female, she makes much less pheromone and becomes less receptive to mating. Using a sophisticated analytical procedure involving mass spectrometry and high-performance liquid chromatography, Bodnar's group then determined the sequence of amino acids in this peptide. The peptide may prove useful in controlling corn earworms; it may "trick them into thinking they have already been fertilized," Bodnar says.

Tiny semiconductor can't take the heat

Scientists used to think every material exhibited a characteristic melting point. During the past 20 years, however, researchers have realized that when they make extremely tiny particles of metals, inert gases or molecular crystals, the melting point drops, sometimes by a lot. Now Avery N. Goldstein and his colleagues at the University of California, Berkeley, have shown that semiconductors also behave this way.

The researchers observed spherical nanocrystals of cadmium sulfide using transmission electron microscopy. When they heated the crystals, they saw that the smallest crystals melted at a temperature 1,000 kelvins lower than bulk cadmium sulfide, Goldstein and his colleagues report in the June 5 SCIENCE.

"From a practical viewpoint, it's a big drop," says A. Paul Alivisatos, the chemist who headed the Berkeley group. Electronic components are rapidly shrinking to submicrometer dimensions, small enough that these effects may inhibit a component's ability to function at high temperatures.

With just a few hundred or a few thousand atoms per particle, the lower number of atoms overall translates into lower cohesive energy for the particles, says Alivisatos. Thus the atoms can escape the solid phase much more readily.

Database to aid chemical identification

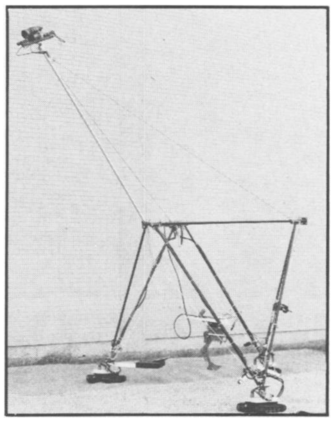
Analytical chemists trying to discover the chemical makeup of mysterious substances can now match their data with 8,200 new "fingerprints" of chemical compounds. Those fingerprints are mass spectra, graphs whose peaks show the relative distribution of molecules of different weights in a sample. Scientists often pinpoint the identity of new substances by causing them to break down and then using mass spectrometry to analyze the molecular weights of the resulting pieces. The chemical makeup of a substance determines the sizes and relative amounts of these pieces.

The new fingerprints belong to the recently updated NIST/EPA/NIH Mass Spectral Database, which now contains spectra of 62,235 chemicals relevant to environmental, medical and chemical studies, says Stephen E. Stein, manager of the Mass Spectrometry Data Center at the National Institute of Standards and Technology (NIST) in Gaithersburg, Md.

NIST made the updated database available this month on magnetic tapes and diskettes for personal computers. The last update occurred in 1990.

Technology

NIST cranks up an incredible crane



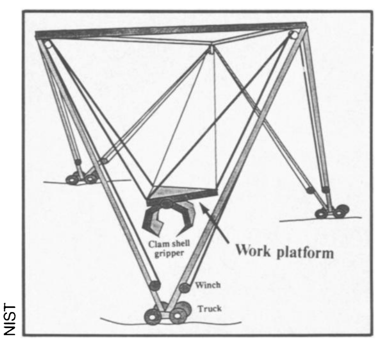
NIST

This 20-foot crane comes with "eyes."

Though seemingly spindly and precariously balanced, a new crane called SPIDER may prove itself mightier than its more traditional – and bulkier – counterparts. Scalable to a size that can straddle buildings, the crane can lift and position heavy loads precisely, according to its inventor, James S. Albus, at the National Institute of Standards and Technology (NIST) in Gaithersburg, Md. The crane also qualifies as a robot that users can fit with sensors, camera "eyes" and motorized platforms.

Albus had fashioned a prototype SPIDER (Stewart Platform Independent Drive Environmental Robot) in his basement. Then last year, he and fellow engineers at NIST decided this robot crane might prove useful in fighting the oil fires that raged in the aftermath of the Persian Gulf War. SPIDER never made it to Kuwait, but the NIST engineers did build a 20-foot model and demonstrate that it can outperform other cranes.

The secret to SPIDER's strength lies in the Stewart Platform, a device developed 30 years ago for airplane simulators. It consists of upper and lower platforms connected by six pistons. NIST engineers improved on that design by replacing the pistons with cables and winches, says Roger V. Bostelman, an electrical engineer at NIST.



NIST

Novel design for new robot crane.

Thus, SPIDER looks nothing like a typical crane, says Bostelman. An octahedron of aluminum tubing forms the crane's support structure. Two pulleys hang down from each of the three corners of this octahedron's top triangle – the upper part of the Stewart Platform. Each pulley supports a cable. Together, the six cables connect that top triangle to the second, lower level of the Stewart Platform. This second level is a small, triangular work platform to which tools or grabbing devices attach. The winches that control the six cables can work independently or in synchrony to tilt, spin or move the platform – and a load – up, down or sideways at the desired speed.

In most cranes, the load-bearing cables work in series to pick up a load. SPIDER's cables work simultaneously. With SPIDER, an operator can maneuver an I-beam to within a millimeter of its target and can hold an object within half a degree of the correct angle of rotation, says Bostelman.

Nor does this crane need any counterweight, as a tower crane does, for example. "All the forces are directed back onto themselves," he explains. So the 1,000-pound SPIDER can lift and hold far more than its own weight – up to 6,000 pounds, or 3,000 pounds with a 50 percent safety factor.

Yet "it's very simple to build," Bostelman points out. The NIST engineers envision SPIDERs with 400-foot-high towers supported by guy wires and even larger models for underwater operations, says Albus. They foresee many uses for the robot crane, which they hope will one day become familiar equipment at construction sites here on Earth and even on the moon.