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New Materials Push The Limits

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Swallowtail butterflies unharmed by a Bt corn

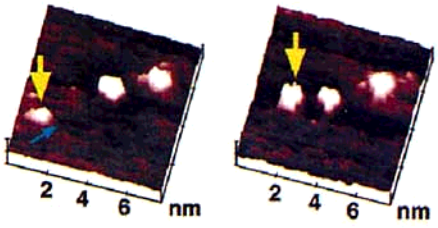
Field experiments with a strain of corn genetically engineered to produce a natural insecticide and widely grown in Illinois indicate that its pollen does not harm black swallowtail butterflies. Those findings are in sharp contrast to Cornell University lab experiments—widely publicized a year ago—that showed pollen from a different strain of so-called Bt corn killed monarch butterfly caterpillars. The genetically engineered plants are designed to protect themselves from corn borers by expressing a toxin from the bacterium *Bacillus thuringiensis*. In the current work, entomology department head May R. Berenbaum and coworkers at the University of Illinois, Urbana-Champaign, placed swallowtail caterpillars on wild parsnip plants at the edge of fields of Bt corn [*Proc. Natl. Acad. Sci. USA*, published June 6 Early Edition, http://www.pnas.org/papbyrecent.shtml]. The researchers found no correlation between caterpillar deaths during the test and proximity to the field or the amount of pollen deposited on the plants. In addition, pollen from the same strain of Bt plants failed to kill swallowtail caterpillars fed pollen in the lab, even at the highest doses. Pollen from a strain that contains higher levels of the Bt toxin, however, did kill caterpillars in the lab experiments. Field experiments with that strain will take place this summer.◀

Spider neurotoxin uses vicinal disulfide bridge

Disulfide bridges between cysteine residues are a common structural feature of many proteins, but the Australian funnel-web spider appears to put the bridge to a more sinister use. The spider makes a family of insect-specific neurotoxins that contain an unusual disulfide bridge between adjacent cysteines that's critical to the toxin's insecticidal activity, according to Glenn F. King, professor of biochemistry at the University of Connecticut Health Center, Farmington, and colleagues [*Nat. Struct. Biol.*, **7,** 505 (2000)]. The peptide toxins contain 36 or 37 residues and three additional disulfide bridges, the researchers find. These other bridges help configure the molecule so that it has two strikingly dissimilar faces: One face presents an almost continuous charged surface, while the opposing face, which contains the vicinal disulfide, lacks any ionizable side chains. The toxins can be folded nonenzymatically in the test tube with 100% efficiency, making them promising candidates for expression in insect-resistant plants or in viruses engineered to infect insects, the researchers suggest.◀

Molecular abacus with cyclodextrin 'beads'

Japanese scientists have shown that a scanning tunneling microscope (STM) can be used to reversibly shuttle cyclodextrin molecules back and forth on a poly(ethylene glycol) (PEG) strand, producing what the authors call a "molecular abacus" [*J. Am. Chem. Soc.*, **122,** 5411 (2000)]. Hidemi Shigekawa of the University of Tsukuba and the University of Tokyo, Makoto Komiyama of the University of Tokyo, and coworkers use the STM tip to push cyclodextrin molecules—singly and in pairs—along the PEG rail, while the other cyclodextrin molecules stay in place by noncovalent binding to the rail. In the STM images shown here, a cyclodextrin molecule (arrow) is moved from one position to another on the polymer chain. The researchers achieved stable imaging at room temperature in air; the usual requirements for such experiments have been low temperature and ultrahigh vacuum. The authors say their results could lead to high-density memory storage devices.◀



Atomic-scale view of antiferromagnetic film

Using a spin-polarized scanning tunneling microscope (STM) combined with first-principles calculations, a research team in Germany has produced the first atomic-scale images of the magnetic structure of a 2-D antiferromagnetic film [*Science,* **288,** 1805 (2000)]. In such a film, theory predicts that the magnetic moments of adjacent atoms are antiparallel, and thus the material as a whole appears to have no net magnetism. Although antiferromagnetic films are widely used in magnetic storage devices and sensors, scientists don't have a clear idea of their microscopic structure. Matthias Bode of the University of Hamburg's Institute of Applied Physics and Microstructure Research Center and coworkers coat an STM tip with magnetic iron or gadolinium, making the tip sensitive to the spins of tunneling electrons. When this tip is used to image a monolayer of chemically identical manganese atoms on a tungsten surface at 16 K, the resulting image shows a striped pattern corresponding to the predicted magnetic "superstructure." An STM image obtained using a nonmagnetic tip shows the diamond pattern corresponding to the chemical unit cell. The work provides direct proof of the predicted 2-D antiferromagnetic state of a manganese monolayer on tungsten, the researchers point out.◀

Science Roundup

- Building on their single dip-pen nanolithography method, chemists Chad A. Mirkin and Seunghun Hong of Northwestern University now can draw eight identical nanosized structures simultaneously [*Science,* **288,** 1808 (2000)]. The procedure could lead to a 1,000-pen nanoplotter, they say.
- Recombinant and natural forms of the hormone erythropoietin (EPO), which boosts the production of red cells, can be differentiated by isoelectric focusing, report scientists at the National Anti-Doping Laboratory in Châtenay-Malabry, France [*Nature,* **405,** 635 (2000)]. The method could be used to detect whether athletes have broken sports rules by taking recombinant EPO to increase their aerobic capacity.
- *Geochemical Transactions*, a new electronic journal, has been launched by the U.K.'s Royal Society of Chemistry and the American Chemical Society's Division of Geochemistry. The peer-reviewed journal can be found at http://www.rsc.org/geochem.
- Readers who access journals online now can click on a reference in one article to jump to the abstract or full text of a cited paper. ACS is one of 33 publishers that will link their journals through the new CrossRef service (C&EN, Nov. 22, 1999, page 55).◀