High-tech microscope makes molecules move

Like the early microscopists of the 17th century, who peered at anything that fit under their lenses, modern scientists are just beginning to explore the power of the atomic force microscope to image atoms and molecules, and even to move molecules. That power may one day lead to a new generation of biosensors and microchips, they suggest.

Developed in 1985, the atomic force microscope features a scanning tip that "reads" surfaces with atomic resolution. A computer monitors the tip's varying vertical positions as it sweeps over the molecular features of a surface, and then generates images of the underlying landscape. Scientists now report they have used the device to see how different molecules arrange themselves on a catalytic crystal. What's more, they say they manipulated some of those molecules.

Researchers at the University of California, Santa Barbara, began by looking at how two types of molecules bind to the surface of a zeolite catalyst. Zeolite crystals are often used to break down crude oil and to convert methanol to gasoline. With the atomic force microscope, the team observed molecular interactions on a zeolite used to remove ammonium and phosphate ions during wastewater treatment. They found that molecules bind to the zeolite surface differently depending on whether they are charged. Positively charged t-butyl ammonium ions formed clumps, while neutral t-butanol molecules arranged themselves in an orderly sheet, the group reports in the March 16 SCIENCE.

Visualizing molecular interactions on zeolite surfaces will give chemists a clearer picture of how zeolites speed reactions. Armed with such knowledge, scientists might learn how to alter zeolites to catalyze new reactions and to boost the efficiency of known reactions, says coauthor James E. MacDougall.

More dramatically, the researchers demonstrated that they could move molecules by increasing the force with which the microscope tip scans. To achieve this effect, they used the tip to carve an "X" on the zeolite surface. Like a snowplow, the tip shoved aside molecules in its path.

"The binding and movement of molecules on zeolite crystals justifies hope that in the future it may be possible to see biologically important molecules binding to receptor sites," says physicist Paul K. Hansma, also of the Santa Barbara team. With the atomic force microscope, researchers might someday use arrays of receptor molecules as biosensors, monitoring how they bind other biological molecules and how long the bonds last, he suggests.

In addition, the ability to manipulate smaller and smaller particles may eventually lead to more compact microchips, although such applications would require years of research, Hansma says.

John Foster of the IBM Almaden Research Center in San Jose, Calif., who is also investigating molecular manipulation with the atomic force microscope, comments: "Anytime you can work on a molecular scale it's terrific, but it's too early to predict how this technology may be used by scientists and industry."

– C. Decker

School program cuts adolescent drug use

An educational program that helps seventh-graders identify and resist social pressures to use drugs substantially reduces their consumption of cigarettes and marijuana by the eighth grade, according to a new study. However, initial drops in alcohol use disappeared by the eighth grade, and students who smoked cigarettes regularly by junior high school smoked even more after participating in the prevention program.

Despite these limitations, "school-based programs have important potential for decreasing substance use among young people," contend Phyllis L. Ellickson and Robert M. Bell of the RAND Corp. in Santa Monica, Calif., in the March 16 SCIENCE.

Many prevention efforts targeting teenagers have failed because they emphasized only long-term dangers of drug use and sometimes exaggerated harmful effects, the researchers say. The new approach, known as Project ALERT, explores social pressures to use alcohol, cigarettes and marijuana and offers students a repertoire of strategies for resisting those pressures. Students take part in small group exercises and practice techniques for dealing with peer pressures to use drugs.

All seventh-graders at 30 junior high schools in California and Oregon participated in Project ALERT between 1984 and 1986. The schools encompass urban, suburban and rural settings. Nine are attended mainly by students from minority groups, and 18 are located in poor or lower-middle-class neighborhoods.

In 20 schools, students attended weekly sessions for two months, as well as three "booster" lessons early in the eighth grade. An adult health educator taught the program in 10 of the schools; high school students assisted adult teachers in the other 10. Ten control schools did not receive the curriculum.

Compared with students at control schools, Project ALERT participants reported modest reductions in alcohol use three months after the program ended, but their drinking rapidly returned to former levels and held steady through the booster lessons. The widespread availability and use of alcohol throughout society apparently undermined messages about resisting pressures to drink, the researchers maintain.

Cigarette "experimenters," who reported smoking fewer than three times in the previous year and not at all in the month before the program began, smoked markedly less than controls after the sessions ended and maintained those levels through the booster lessons. However, students who already used cigarettes regularly by seventh grade actually smoked more after Project ALERT. These individuals had a number of family and behavior problems, and were probably most influenced by heavy-smoking friends, Ellickson and Bell say.

On the other hand, Project ALERT markedly curbed initiation of marijuana use and reduced current use among students who had not tried marijuana or cigarettes by junior high. It also held down marijuana use among students who already smoked cigarettes, a group at high risk of trying marijuana. *– B. Bower*

AIDS drug sparks concern

In some patients, the experimental AIDS drug dideoxyinosine (DDI) appears to increase the risk of death from pancreatitis, an inflammation of the pancreas. Researchers expressed concern about the link last week after DDI manufacturer Bristol-Myers Squibb Co. of New York City said six AIDS patients taking DDI had died of pancreatitis and that five of those were enrolled in a federally approved program that allows widespread distribution of DDI.

About 8,000 people with AIDS took advantage of the Food and Drug Administration's decision last fall to approve the expanded-access program, which allows Bristol-Myers Squibb to provide DDI to severely ill AIDS patients who fail to qualify for clinical DDI trials (SN: 10/7/89, p.231). Participating patients get DDI from private physicians who agree to inform the manufacturer of any problems. Now Bristol-Myers Squibb reports 290 deaths out of 8,000 people enrolled in the program, with five of those deaths due to pancreatitis, says spokeswoman Kathryn Bloom. In contrast, the company reports two deaths (one due to pancreatitis) among the 700 AIDS patients enrolled in Phase II clinical trials.

"Bad news like this makes you want to look more closely at how [the access program] is being administered," says Jeffrey Laurence of the Cornell University Medical College in New York City. Bloom contends the higher overall death rate among expanded-access patients stems from the severity of their illness upon entering the program. □