UV light makes microscopic cracks glow blue

With lasers, materials scientists become surgeons, performing delicate operations with micrometer precision. They sculpt minute features into thin films (SN: 8/22/92, p.119) and zap materials to knock off atoms and deposit them elsewhere. This laser ablation yields ceramic coatings and high-temperature, superconducting thin films.

Now physicists have discovered an easy way to monitor a laser's interaction with inorganic crystals. In ultraviolet (UV) light, atomic-size nicks or defects glow bright blue, says Tom Dickinson of Washington State University in Pullman.

At the Materials Research Society meeting in Boston last week, he described how this simple visualization technique helps him understand laser ablation and possibly create tougher ceramic materials. "It's a new way to look at the [development of] fracture in brittle materials," Dickinson told SCIENCE NEWS.

These results represent "a real change in the way that people look at how light is absorbed on surfaces," adds Richard F. Haglund Jr., a physicist at Vanderbilt University in Nashville, Tenn.

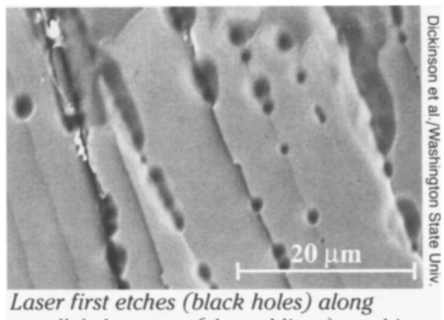
Dickinson's group first noticed this luminescence when they aimed an intense laser through a material that was supposedly transparent to the laser. Over time, however, the material lost its transparency because the laser caused tiny fractures. Under UV light, those fractures showed up as many minute cleavages, all ringed with blue light.

"It's fairly spectacular to the eye," Dickinson says.

By bathing a sample in a low-intensity UV laser while processing and then photographing the luminescence through a microscope, he expects to be able to study the evolution of these defects. "We now have a way of finding spatially where the crystal has deformed," he adds.

These deformations mark vacancies in a crystal's orderly array of atoms. Such gaps occur when external energy causes a cluster of atoms in this array to shift, while one atom in the cluster lags behind. This atom falls into a space between two other atoms, leaving its spot in the array empty, he says. Electrons flow into these spots; when light hits them, they get excited and give off the blue light.

A very intense laser can cause these dislocations to develop, but so can mechanical forces, such as scratching with a diamond tip. "And on a polished surface of these crystals, the luminescence is everywhere," says Dickinson. These microscopic cracks can make materials such as ceramics more likely to break.



Laser first etches (black holes) along parallel cleavages (slanted lines) marking high concentrations of glowing defects.

"[Dickinson] has worked very patiently to demonstrate the link between microcracking and these defects," says Haglund. "It's a way of identifying what defects are there and a way of cleaning them up." Scientists can then use a laser to "smooth out the damage so it would be a more perfect surface," Dickinson says.

This nondestructive technique could also enable researchers to fine-tune laser ablation. While studying the effects of laser ablation on a magnesium oxide crystal, Dickinson and his colleagues observed that the laser chips away atoms along the blue-light-emitting cleavages in the crystal. "If we can control where the defects are, then we may be able to control where ablation occurs," says Dickinson. "I think we can get down to 1 micron resolution." *– E. Pennisi*

Football players benched by foul foods

Everybody knows airplane food can taste bad. But can it make you sick?

Epidemiologists now detail an incident in which a professional football team had to take time-out after eating contaminated sandwiches prepared by a commercial airline. A related study suggests that the cheese you put on your sandwich may also harbor a disease-causing microbe.

Taken together, the two studies raise a question about the quality of deli-style foods: "How safe is the food supply?" asks epidemiologist Michael T. Osterholm of the Minnesota Department of Health in Minneapolis. Osterholm is an author of both studies, which appear in the Dec. 9 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION.

The case of the foul cheese caught the attention of Minnesota health authorities when a state laboratory documented a sharp rise in infections with *Salmonella javiana,* a relatively rare type of *Salmonella.* This bacterium can cause diarrhea, fever, and other symptoms of food poisoning.

Osterholm's team investigated and found 147 cases of *Salmonella* poisoning in Minnesota, 15 cases in Wisconsin, and one case each in New York and Michigan. By comparing these sick people to other people in the community, the team identified the culprit: cheese tainted with *S. javiana* or *S. oranienburg,* another strain of *Salmonella.* The *Salmonella* cases were more likely than controls to have eaten mozzarella cheese manufactured at a certain Wisconsin cheese plant or other types of cheese that had been contaminated by the bad mozzarella, the team found.

The researchers note that inspections of the Wisconsin plant revealed inadequate sanitary procedures. *Salmonella* from the mozzarella made in this plant contaminated equipment in other plants that shredded the cheese. This equipment then passed on the bacteria to other cheeses processed by those plants.

Epidemiologists have long known that *Salmonella* can cause food poisoning when people eat tainted poultry or eggs (SN: 8/18/90, p.109). However, the new study suggests that cheese can prove an important source of *Salmonella* poisoning as well, says Patricia M. Griffin of the Centers for Disease Control and Prevention in Atlanta.

In the second study, Osterholm's team investigated an outbreak of food poisoning that hit the Minnesota Vikings in October 1988. This time, the researchers traced the problem to *Shigella sonnei,* another microbe that can cause gastrointestinal illness.

The Vikings alerted the Minnesota Department of Health after members of the team and staff suffered from diarrhea, chills, and fever a few days after a football game that took place in Miami. Investigators learned that the team had eaten roast beef, turkey, and ham sandwiches that had been prepared by a commercial airline's kitchen and then shipped along with the team to Florida. The sandwiches were left unrefrigerated in the locker room during the Miami game, a fact that allowed *Shigella* to flourish and cause the severe flu-like illness that felled some of the players and staff, Osterholm notes.

After news reports of the case, the Minnesota Department of Health was contacted by more than 700 people who had suffered from a gastrointestinal illness after flying on planes operated by the airline in question. Osterholm's team subsequently identified 240 passengers on 219 flights who had or probably had *Shigella* infection. Again, the researchers traced the problem back to the flight kitchen. The researchers believe that workers there had contracted *Shigella* and passed this microbe on during food preparation.

– K. A. Fackelmann