A quick stamp for a new optical sensor?

What could be easier than stamping "first class" onto an envelope? All one needs is a rubber stamp and some ink. Without much effort, one could imprint a thousand envelopes in an hour.

Now, suppose one could make a simple sensor with equivalent ease.

According to a report in the Jan. 7 SCIENCE, building such simple sensors may soon be possible. Chemists George M. Whitesides of Harvard University and Amit Kumar of the Idetek Corp., in Sunnyvale, Calif., describe a technique for stamping a pattern onto a thin film that allows small droplets of liquid to condense in ordered arrays. When the scientists shine a laser onto that surface, the tiny droplets diffract, or break up, the beam in a distinct way, allowing them to detect what lies on the thin-film surface.

In essence, this method uses tiny water droplets as an optical diffraction grating to scatter light, similar to what a prism does. This system could make possible a new type of sensor, one capable of detecting anything from humidity in the atmosphere to viruses in human blood.

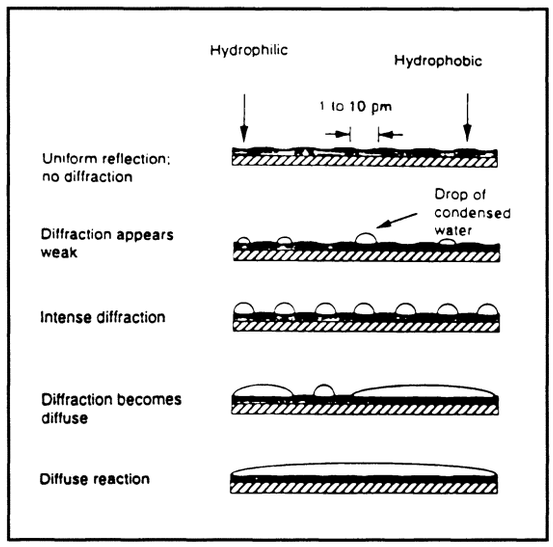
"This paper is a proof of concept," Kumar says. "What we've done is to show that this technique can be used to make sensors. We've developed a method to make a rubber stamp, ink it with a chemical, and then stamp a pattern onto a thin film of gold. This process is so simple that you can stamp out a thousand of these patterns in an hour, which is important because conventional [production] methods require labor-intensive lithography."

Significantly, the patterned surfaces can serve as sensors. "We've shown that they work as good sensors for temperature and humidity," Kumar adds. "But in principle they could act as sensors for any type of molecule that will bind selectively to the surface – for instance, specific kinds of antibodies, antigens, cells, or other molecules."

Fashioning a stamp from a common polymer, then "inking" it with the water-repelling chemical alkanethiol, the scientists pressed a checkerboard-like pattern onto a thin film of gold, creating an array of "hydrophobic" one-micrometer squares. They then placed the gold film in a humid environment and slowly cooled it, watching tiny droplets form on the unstamped "hydrophilic" regions. As the gold film cooled, more droplets formed.

When Whitesides and Kumar shined a laser onto the cooling surface, they could measure the intensities of the diffraction patterns at various temperatures. At higher temperatures, fewer droplets caused less diffraction; at lower temperatures, more droplets caused greater diffraction. Consequently, they could use the diffraction patterns to figure out the temperature of the sensor, based on the amount of condensed water on the surface.

As the film's surface cools, water droplets form, diffracting a laser beam.



"In theory, we can use this method to sense many types of molecules," says Kumar. "If I wanted to detect [evidence of] HIV in blood, I could stamp squares onto a surface with the antigen for HIV antibodies. If I dip the sensor into a blood sample, then remove it, wash it, and shine a laser on it, a diffraction pattern will show up if antibodies have attached themselves in those squares."

The possibilities, says Kumar, seem endless. Any molecule that will bind selectively to a stamped square – including biological agents, enzymes, pesticides, or toxins – is detectable using this technique.

"And these sensors are so easy to make," Kumar adds. "Once you've made the rubber stamp, you can stamp thousands of surfaces. It's as easy as stamping 'airmail' onto an envelope." *– R. Lipkin*

Veggies may cut nonsmoker lung cancer risk

Smokers who can't or won't quit can still reduce their chances of getting lung cancer by eating plenty of fruits and vegetables, researchers believe. Now a new study suggests that a diet rich in fresh produce also may protect nonsmokers from this deadly disease.

Cigarette smoking remains the culprit in most cases of lung cancer. Yet this disease also claims the lives of about 22,350 nonsmokers in the United States annually. That toll represents 15 percent of all U.S. lung-cancer deaths.

A few studies previously had looked at dietary factors and the risk of lung cancer among nonsmokers. This research examined risk only among small groups of nonsmoking women. The new study is the largest so far and the first to include men, points out Susan Taylor Mayne, an epidemiologist at the Yale University School of Medicine. Mayne and her colleagues report their findings in the Jan. 5 JOURNAL OF THE NATIONAL CANCER INSTITUTE.

The team recruited 413 lung cancer patients and another 413 men and women who served as controls. All participants in the study were either nonsmokers or had quit smoking at least a decade prior to the study. Researchers asked the volunteers to estimate their usual consumption of 26 different food items. In some cases, a spouse or a close relative answered dietary questions when a lung cancer patient was very ill.

A statistical analysis showed that consumption of raw vegetables and fresh fruits significantly reduced a nonsmoker's chance of developing lung cancer. Mayne estimates that, on average, nonsmokers can reduce their lung cancer risk by 40 percent by simply adding one-and-a-half servings of such fruits or veggies to their daily diet.

The National Cancer Institute (NCI) recommends eating five or more servings of fruits and vegetables every day. However, most Americans still fall far short of this dietary goal, Mayne points out.

The new study suggests that fruits and veggies are more potent cancer fighters when raw than when cooked or processed. Extreme temperatures during cooking or processing may destroy certain nutrients – such as beta carotene – that provide an antitumor effect, Mayne notes.

The consumption of whole milk increased lung cancer risk, a finding that needs further study. The fat in whole milk may actually cause that added jeopardy, or whole milk may simply identify people with lifestyles that put them at added risk for lung cancer, Mayne says.

In an intriguing twist, the researchers found evidence that nonsmokers were protected from lung cancer when they included cheese in their usual diet. That finding fits with research conducted by Michael W. Pariza at the University of Wisconsin-Madison. Pariza's data suggest that a fatty acid in cheese (conjugated linoleic acid) has antitumor properties (SN: 2/15/92, p.104).

"There's no question that conjugated linoleic acid is a very effective cancer inhibitor in rodent models," Pariza says. What does that mean for humans? "We have no idea," Mayne cautions, adding that her findings on cheese remain very preliminary. *– K.A. Fackelmann*