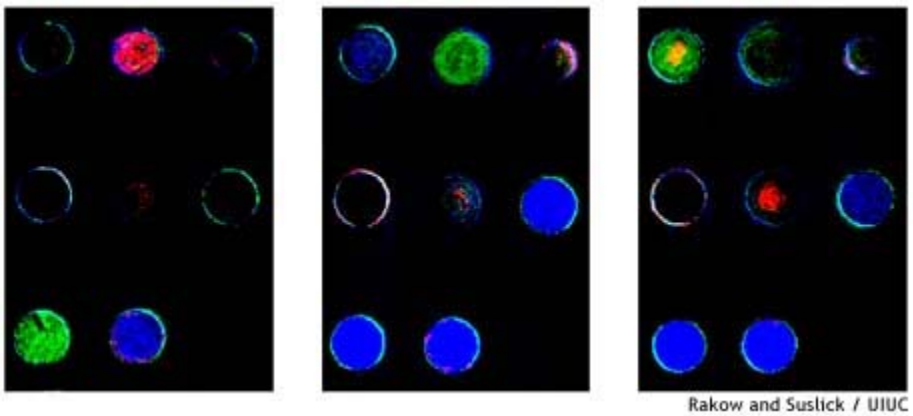
What's that smell? Get a good look

Scientists develop 'litmus paper' for analyzing odor chemistry



Rakow and Suslick / UIUC

These are close-ups showing how the "smell-seeing" array changes color in the presence of three common odors. From left to right, the scents come from cinnamon, rum and overripe fruit.

By Alan Boyle
MSNBC

Aug. 16 — A new "smell-seeing" technique can be used to produce a visual fingerprint of odors ranging from sour milk to toxic gases to the scent of contraband, scientists say.

COMPLETE STORY

MSNBC
Alan Boyle
SCIENCE EDITOR

THE INVENTION consists of an array of dots that can be painted on a backing such as paper, plastic or glass. The "paints" are actually a variety of vapor-sensitive dyes known as metalloporphyrins, first cousins to the natural pigments found in red blood and green plants.

By checking how the colors change in the presence of an aroma, scientists could determine what the aroma smelled like. The idea is "basically an extension of litmus paper," which changes color to reflect the acidity or alkalinity of a substance, said Kenneth Suslick, a chemistry professor at the University of Illinois.

Suslick and another Illinois chemist, Neal

Rakow, described the invention in Thursday's issue of the journal Nature.

Suslick told MSNBC.com that the "smell-seeing" technology could have wide application in everyday life.

"Wouldn't it be nice to have a sensor on your refrigerator that says, 'Time to clean something out. ... There's something that smells bad.' Or on your microwave that says, 'Time to take the food out, it smells done,'" he said.

He rattled off a litany of additional applications: to measure workers' exposure to potentially hazardous chemicals in chemical, pharmaceutical, petroleum and microelectronics plants; to detect toxic gas in the home or on the battlefield; to identify banned drugs, plants or other contraband at customs stations; to monitor quality at food processing plants.

"The perfume industry would find something like this useful for comparisons between counterfeit perfumes and the originals," he said.

HOW IT WORKS

To determine the signatures of smells, researchers recorded the color patterns on a swatch of spotted silica gel, then exposed the swatch to a variety of vapors. The next step was to subtract the "before" pattern from the "after" pattern, using image-processing software. That gave the researchers quantitative data that could be matched up with the chemical composition of the vapors.

Artificial noses are nothing new: Scientists have long used chemical sensor arrays and pattern-recognition software to analyze scents. However, the other sniffing techniques can be thrown off by variations in humidity, which limits their usefulness in real-world applications, Suslick said.

"Our arrays are completely independent of water content, so you could do this in the Gobi Desert or you could do it in downstate Illinois in August, and it won't matter," he said. "You get the same pattern."

The color changes also provide a quick, visual readout of a smell rather than a computerized rundown. That's good for situations when human eyes have an advantage over complicated computer analyses, odor-sensing specialist Ingemar Lundström of Sweden's Linköping University observed in a commentary also published in Nature.

"It is intriguing to be able to identify different smells by eye," he said. "Such a system could be used to monitor levels of insecticides in the environment or to sniff out bacteria causing

infections."

He said "we have not yet seen the last development in systems to detect specific chemical interactions and, in particular, to 'see the smell.'"

NOSE-TO-NOSE

Rakow and Suslick reported that their smell-seeing patches could detect vapors ranging down to 35 parts per billion. For some smells, such as ethanol and gasoline, that's 10 to 100 times better than the human nose can do, Suslick said. But for other smells, the human nose still knows better: We can pick up the whiff of rotten eggs (hydrogen sulfide) at 18 parts per billion, and the stink of a skunk (thiols) at 1 part per billion.

Rakow And Suslick / UIUC

An experimental "Smell-Camera" has a small sensor plate mounted within a plastic tube that's attached to the front of an off-the-shelf digital camera. Testers can take pictures that record how colors change on the scent-sensing plate.

The research was funded by the National Institutes of Health, the Department of Energy and the Department of Defense. Rakow and Suslick have applied for a patent, and Suslick said "we're really moving quite far along" on commercialization of the technology.

They've already come up with an experimental "Smell-Camera" that could be used to take snapshots of a smell. The device is simply an off-the-shelf digital camera with a plexiglass tube mounted in front of the lens. Within the tube is a tiny plate covered with spots of the odor-sensitive dyes. Suslick said the camera provided a simple way to point and shoot at an odoriferous substance.