SURFACE ANALYSIS

SHINY LABELS FOR SURFACE MOLECULES

Fluorescence method detects tagged species with much-improved sensitivity

CHEMISTS AT THE UNIVERSITY of Pittsburgh have developed a selective fluorescence-based technique capable of detecting very low concentrations of analytes on surfaces. Compared with established analysis methods, the new procedure boosts detection sensitivity by a factor of 100 for some species and can be applied to a large variety of molecules [*J. Am. Chem. Soc.*, **126**, 2260 (2004)].

Fast-paced research in self-assembling molecular films has led to a large number of synthesis methods and applications. From chemical and biological sensing to fundamental studies of surfaces and interfaces, researchers in several disciplines often need to characterize multicomponent monolayers.

For densely packed homogeneous films in which surface concentrations are on the order of 10^{14} molecules per cm^2, common surface analysis methods such as X-ray photoelectron spectroscopy (XPS) and Fourier-transform infrared spectroscopy (FTIR) are generally adequate. But when the concentration of surface species is just a few percent of a monolayer or less—roughly 10^{12} molecules per cm^2—standard detection methods often tend to be ineffective.

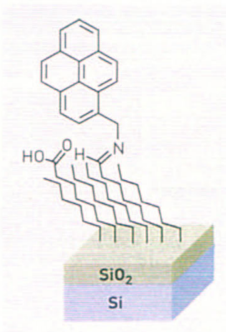
Demonstrating the method, a team of Pittsburgh researchers, including assistant chemistry professors Eric Borguet and Stéphane Petoud and coworkers Eric A. McArthur, Tao Ye, and Jason P. Cross, prepared monolayer films of octadecylsiloxane on silicon and treated the films to form a mixture of oxygen-containing molecules. Then, using various chromophores and selective derivatization reactions, the group labeled the molecules such that each functional group was tagged with a specific chromophore. For example, aldehydes were labeled with 1-pyrenemethylamine, carboxylic acid groups were labeled with 2-naphthaleneethanol, and OH groups were tagged with triphenylmethyl chloride. In a final step, the team measured characteristic fluorescence spectra, which indicated the identity and concentration of the labeled molecules.

Based on a series of detection limit studies, the Pittsburgh group determined that molecules containing carboxylic acids or aldehydes can be detected in the low 10^{11}-molecules-per-cm^2 range. And alcohols can be detected in even lower concentrations—10^{10} molecules per cm^2, a quantity that corresponds to just one ten-thousandth of a monolayer.

"This work is important because FTIR and XPS are so limited in terms of sensitivity," remarks Jillian M. Buriak, a chemistry professor at the University of Alberta, Edmonton. She adds that the technique "is easy to apply and useful for detecting functional groups that are absolutely ubiquitous."—MITCH JACOBY

DERIVATIZE AND SHINE Cross (left), Borguet, and Petoud found that labeling surface species selectively with fluorescent chromophores, such as a pyrene-amine compound (shown below), enables them to detect the molecules in very low concentrations.

COURTESY OF ERIC BORGUET



GENETIC ENGINEERING

Transgenic DNA Found In Conventional Seeds

Both the biotechnology industry and activists concerned about the spread of bioengineered genes agree that recent findings of transgenic DNA in the seeds of conventional crops point to the need for U.S. government action. But they differ on what that action should be.

In a study released by the Union of Concerned Scientists last week, two laboratories examined seeds of six conventional varieties each of corn, soybeans, and canola. One lab found transgenic DNA in half of the corn, half of the soybeans, and all of the canola seeds. The other lab detected genetically engineered DNA in 83% of all seeds tested.

"It is a surprise for most consumers," UCS's Margaret Mellon says, adding that it is especially troublesome to organic food growers and to consumers who want to avoid genetically engineered food.

UCS is calling for the government to investigate the extent and causes of conventional seed contamination with transgenic DNA and to establish a reservoir of nonengineered seeds for food and feed crops.

But Lisa J. Dry of the Biotechnology Industry Organization counters that the finding of bioengineered genetic sequences together with conventional crop seeds is "not a huge surprise" because genetically engineered corn and soybeans are handled in the same machinery as conventional varieties.

She says the findings should spur the government to set a science-based threshold on the amount of transgenic DNA that is acceptable in conventional crops.—CHERYL HOGUE