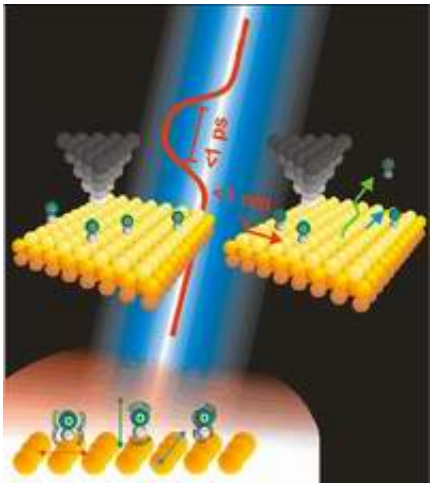
New Breakthrough Physics Technique for Surface Diagnostics

August 5 2004



New method allows scientists to probe fundamental questions of surface science

A team of researchers including University of California, Riverside Assistant Professor of Chemistry, Ludwig Bartels has developed a technique to take extremely fast snapshots of molecular and atomic movement. The development is considered a significant advance in surface science, the study of chemical reactions taking place on the surface of solids. The results are reported in the current issue of the Journal Science and were also reported in the June 24 issue of Science Express... the online prerelease of the most important articles in Science.

The article, "Real-Space Observation of Molecular Motion Induced by Femtosecond Laser Pulses," details how carbon monoxide molecules move on a copper substrate when hit with extremely rapid laser pulses - a femtosecond is one millionth of a nanosecond - and tracks their movements.

"It was possible to identify the individual site-to-site displacements of molecules undergoing ultra-fast dynamics induced by femtosecond laser pulses," Bartels said, characterizing the technique as a way of getting something akin to snapshots of the molecules' movements. Bartels' co-authors in the paper included Tony F. Heinz, Dietmar Möller and Feng Wang of Columbia University; and Ernst Knoesel of Rowan University, Glassboro, NJ.

"Scanning probe microscopy has the capability of reaching directly down to the natural spatial scale of atoms and molecules," Bartels said. "While femtosecond laser techniques have the capability of reaching down to the time scale of atomic events.

"There has been considerable interest in the very challenging problem of combining these two capabilities," he added. "While we have not yet achieved the ultimate goal of a real-time, real-space movies, the current paper reports what we believe to be a very significant advance in combining the two very powerful techniques."

The new technique allows scientists to probe very important fundamental questions in surface science, according to Bartels and his co-authors. They include such questions as what substrate excitations drive surface diffusion of absorbates? Surface diffusion is a very basic and important process in surface science, playing a key role in processes as diverse as the formation of crystals and the activity of catalysts.

"This is very basic research but it has implications for many other areas

in science," said Bartels. "Catalysts, like the one in the exhaust system in every car, are made from a porous material. The exhaust gas is passed through it and the pollutants such as carbon monoxide and nitric oxide can stick to the surface of the catalyst material."

A small portion of the catalyst surface can transform the pollutant into benign gasses while the rest of the surface supports these active sites. Understanding how carbon monoxide moves across a catalyst surface to find the active sites may ultimately allow the design of more efficient catalysts. The article's findings offer a new way of studying the very fast movement of carbon monoxide on surfaces.

The U.S. Department of Energy and the Air Force Office of Scientific Research support this research.

Related Links
* Ludwig Bartels' faculty Web page is at
www.chem.ucr.edu/faculty/bartels/bartels.html
* The Science magazine Web site is at
www.sciencemag.org/content/current/
* An abstract of the article is available at
www.sciencemag.org/cgi/content … bstract/305/5684/648

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