edge. The presence of such states results in a trapped electron potential of -0.39 V, which exceeds the reduction potential of the O_2/O_2^- at pH 7 (–0.16 V), and enables the formation of OH radicals by visible-light irradiation.

The researchers, therefore, analyzed the photocatalytic activity of new materials by observing the degradation of typical pollutants in water and air by artificial and natural light. They observed complete photomineralization of the ubiquitous water pollutant 4-chlorophenol in the presence of the catalyst after 180 min of irradiation with visible light (λ = 455 nm). The researchers also confirmed high photocatalytic activity of the substances by photodegradation of 4-chlorophenol and the azo dye remazol red by illumination experiments in diffused indoor daylight. Furthermore, they found that the catalyst supported on filter paper catalyzes the oxidation of gaseous acetaldehyde, benzene, and carbon monoxide.

ANDREI A. ELISEEV

Micromirrors Fabricated by the Micro-Origami Technique Characterized by Optical Actuation

The development of semiconductors goes hand in hand with research into microelectromechanical systems (MEMS) devices because the latter, in a lot of cases, are built on semiconductors and consequently the progress of semiconductor research depends on the study of micro technologies. J.M. Zanardi Ocampo from ATR Laboratories in Kyoto, T. Ohnishi from Konan University in Kobe, R. Izumoto from Osaka City University in Osaka, and their colleagues addressed the formation of reliable hinges for movable parts of MEMS equipment, by means of micromirrors, and the actuation of the resulting micromirrors. As reported in the November 3, 2003, issue of *Applied Physics Letters*, the researchers have fabricated standing micromirrors by the micro-origami technique they developed in which the hinges bend as the result of strain in a pair of lattice-mismatched epitaxial layers. They then characterized the micromirrors by way of optical actuation.

To form the mirrors, the researchers used GaAs(100) as a substrate, $Al_{0.5}Ga_{0.5}As$/AlAs (40 nm) as a sacrificial layer, and $In_{0.22}Ga_{0.78}As$ (56 nm) as a strain layer, followed by a GaAs (88 nm) spacer layer. On top of that, they grew the mirror plate. They then processed the samples by photolithography and wet etching. Etching was selectively applied first to the component layer, then to all layers down to the etching stop layer and finally to the sacrificial layer. Powered by the strain relaxation of the InGaAs layer, the mirror stands by itself.

An Ar laser beam was focused on the surface to perform actuation of the mirrors. A HeNe laser probe beam was also focused on the mirror's surface and reflected onto a target placed several hundreds of millimeters away from the sample. This image was processed to analyze the mechanical response of the mirror during actuation. When the mirror was irradiated with the Ar laser, the HeNe probe light indicated a deflection in its inclination, which was positive. After the Ar laser optical excitation was interrupted, the mirror returned to its original angle. Thus, the frequency response of these mirrors was studied by applying a modulated optical excitation.

In order to explain this optical actuation, the researchers considered several phenomena. Light radiation pressure would not account for an increase in the mirror's inclination angle, as was found here, but rather a decrease. Actuation by heating and expansion of the surrounding air cannot be the reason because the mirrors move in vacuum as well. Stress by carrier generation remains a possible cause but short surface recombination times in GaAs and thinning of the epitaxial films can impede the actuation. As the researchers report, the most reasonable explanation could be uneven thermal expansion within the materials and thus deformation of the structures.

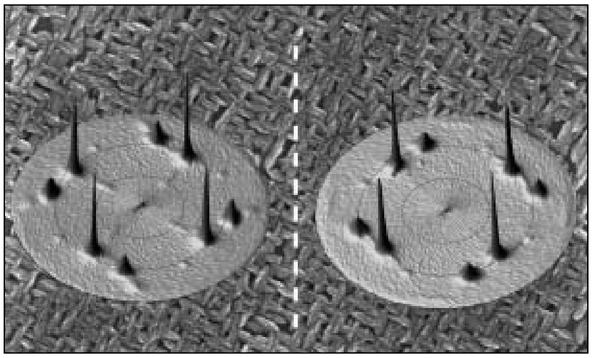
EKATERINA A. LITVINOVA

Chiral Surface Produced through Electrodeposition

J.A. Switzer and colleagues at the University of Missouri—Rolla have developed a process for separating or detecting chiral molecules using electrodeposited chiral surfaces, in contrast to the current process that requires a homogeneous catalyst or an enzyme solution. The electrodeposited chiral surface can then be used as this type of catalyst.

As reported in the October 2, 2003 issue of *Nature*, the researchers immersed a thin layer of gold in a liquid containing copper and the enantiospecific chemical tartrate while applying an electric current to the system. The electricity caused copper oxide to bond to the achiral Au(001) surface. The chirality of the film was determined by the chirality of the tartrate ion in solution. The researchers used x-ray diffraction to determine the orientation of the entire film, and x-ray pole figure analysis to determine the film's absolute configuration (see figure). Initial tests revealed that the material differentiates the enantiomeric forms of the chiral tartrate without breaking down or being permanently altered.

Switzer said, "We've made a material where the entire product is chiral, not just the surface. In earlier experiments, you would modify a surface with a chiral modifying agent, and if the agent washes off, the surface is no longer effective. In our research, the film itself is chiral, so the effectiveness remains even after many chemical reactions."



X-ray pole figures of ~300 nm CuO films electrodeposited onto a Au(001) surface. The background is a scanning electron microscope image of one of the CuO films. The pole figures—which represent data, not images of molecules—were created by use of an x-ray diffractometer.

Switzer said that the production of chiral surfaces is significant for the synthesis and detection of chiral molecules such as pharmaceuticals.

Photosensitive Membrane Fabricated by Molecular Imprinting

Molecular imprinting technology is an emerging method for the preparation of synthetic materials that use molecular recognition for selective separation and chemical identification. To prepare molecularly imprinted polymers (MIPs), a functional monomer and a cross-linker are polymerized in the presence of a template molecule. The template is then extracted, leaving cavities that are complementary in both shape and chemical functionality