face of a light-emitting diode to form a pin-printed optical-sensor array and integrated light source (PPOSAILS). Work on true distributed sensor arrays and biosensor arrays is now under investigation in their laboratory.

YUE HU

Organic-Based Magnet $Mn(TCNE)_x \cdot y(CH_2Cl_2)$ Shows Photoinduced Magnetization

D.A. Pejakovic and colleagues at the Ohio State University and the University of Utah have reported reversible photoinduced magnetization (PIM) in an organic-based magnet, Mn(tetracyanoethylene)$_x \cdot y(CH_2Cl_2)$ ($x \sim 2$, $y \sim 0.8$). At low temperatures, the PIM lasts for several days after illumination.

As described in the February 4 issue of *Physical Review Letters*, for dc magnetization (M) measurements, the polycrystalline material was dispersed in mineral oil and sealed in a quartz capsule. At 5 K, illumination with 2.54-eV argon laser light in a 10-Oe magnetic field increased M. After illumination, M initially increased due to sample cooling and then decreased by about 0.5% in 60 h, suggesting a PIM lifetime of $>10^6$ s.

The ac susceptibility (χ_{ac}) of about 0.05 mg of the material applied in a thin layer on adhesive tape increased substantially below $T_c = 75$ K after illumination with 2.7-eV argon laser light for 60 h at 90 K. In the range of 13–18 K, χ' increased more than 50%, and χ'' increased by more than a factor of 4. The researchers suggest that the increase originates in altered spin organization and/or spin-spin coupling. After heating to 200 K and cooling to 5 K, about 5% of the increase in χ' remained. However, heating to above 250 K returned the material to the original state.

After illumination with 2.54-eV light for 10 min, the UV–vis–NIR absorption spectrum shows photoinduced absorption in the 1.5–2.4-eV and 3.1–3.8-eV regions. After illumination, 2.41-eV line excitation can reduce the effects. The researchers suggest that PIM results from a photoinduced electronic transition into a metastable state that enhances charge transfer.

The change in the IR absorption spectrum was also measured after 10 min of illumination at 2.54 eV. Again, the photoinduced effect is partially reduced after illumination with the 2.41-eV line. The changes in the IR spectrum suggest the presence of a lattice distortion occurring when a fraction of electrons relax from the π^* level. The researchers speculate that the lattice distortion plays a key role in stabilizing the state with enhanced magnetization.

ELIZABETH SHACK

X-Ray Microdiffraction Allows Direct Study of Antiferromagnetic Domain Evolution in Chromium

The evolution of antiferromagnetic domains in chromium during a "spin-flip" transition has been observed by x-ray microdiffraction imaging. A team of researchers from Lucent Technologies, NEC Research Institute, and Argonne National Laboratory report in the February 8 issue of *Science* that the transition begins at the walls between domains with orthogonal modulation vectors and progresses inward during cooling.

In contrast to ferromagnets, in which the spin polarization alone characterizes the magnetic domains, the description of antiferromagnetic chromium requires two parameters: the spin polarization and the modulation wave vector. Despite its structural and compositional simplicity, chromium displays complex magnetic behavior: During cooling, it not only undergoes a transition between a disordered paramagnetic state and an ordered Néel state, but also a spin-flip (SF) transition between two Néel states with perpendicular spin polarizations at T_{SF}.

"It is important to understand the domain evolution during this spin-flip transition," said Paul Evans, a postdoctoral researcher at Lucent. "However, we needed a technique that allowed us to image the domains by following the spin polarization and the modulation wave vector with good spatial resolution."

The researchers observed the spin-density wave and charge-density wave (SDW and CDW) under magnetic x-ray microscopy. They focused the x-ray microprobe beam to a spot size of 0.5 μm using a Fresnel plate followed by an order-sorting aperture. SDW Bragg reflections resulting from the ordered antiferromagnetic state were observed close to reciprocal space points (h,k,l) with $h + k + l$ odd, where no Bragg peaks resulting from atomic cores were observed from the bcc structure. CDW reflections due to the coupling of spin and charge had half the period of the SDW. For the measurement of (0,0,1 – δ) SDW reflections and (0,0,2 – 2δ) CDW reflections, the research team used 5.8-keV and 11.6-keV x-rays, respectively.

E.D. Isaacs, director of semiconductor physics research at Lucent, said, "If we mount the crystal in the right orientation, any transverse spin polarization gives us Bragg intensity, while longitudinal spin polarization does not fulfill the Bragg law."

Using this technique, the researchers followed the SDW and CDW during cooling through the spin-flip transition at ~123 K. While the CDW remained unchanged above and below the transition, the scattering intensity due to the SDW decreased with temperature, which was due to the reorientation of spins from transverse to longitudinal below T_{SF}. Additionally, it could be shown that different points of the same SDW domain converted at temperatures that differed by up to 7 K. The researchers attributed this to an inward progression of the spin-flip transition that started at antiferromagnetic domain walls. According to the researchers, possible explanations for this phenomenon are local strain fields, Heisenberg exchange interactions, and the quantum mixing of states with different Fermi surfaces across the domain walls.

CORA LIND

Magnetic Resonant Mode Discovered in Single-Layer HTS $Tl_2Ba_2CuO_{6+\delta}$

High-temperature superconductors (HTSs) with crystal structures consisting of copper oxide bilayers exhibit a resonant spin excitation mode. The observation of this unusual mode in the bilayer materials has prompted numerous theoretical studies of the interaction between charged quasiparticles and collective spin excitations in these superconductors. Previous experiments on single-layer $La_{2-x}Sr_xCuO_{4+\delta}$ did not show this magnetic resonant mode. Researcher H. He and colleagues from the Max-Planck-Institut für Festkörperforschung, CEA-CNRS, CEA-Grenoble, and the Russian Academy of Sciences have performed neutron-scattering experiments that show the presence of this mode in $Tl_2Ba_2CuO_{6+\delta}$, a single-layer copper oxide material with a superconducting transition temperature T_c of ~90 K. Based on these results, the researchers suggest that the mode is a general feature of all copper oxide superconductors, regardless of the sequence of layers.

At currently available neutron sources, inelastic neutron scattering requires a minimum single-crystal volume of 1 mm^3. The only known single-layer copper oxide superconductors, with $T_c \sim 90$ K, are Tl- and Hg-based and have typical crystal volumes well below 1 mm^3. As reported in the February 8 issue of *Science*, the researchers synthesized ~300 single crystals of $Tl_2Ba_2CuO_{6+\delta}$, each with volumes of up to 3 mm^3, using a CuO-rich flux technique. The relatively large crystals were then aligned into a larger mosaic of 0.11 cm^3 (total volume) by using Laue x-ray diffraction to measure the alignment of their crystallographic axes to an accuracy of 1.5°.

The researchers reported that inelastic neutron-scattering measurements of optimally doped $Tl_2Ba_2CuO_{6+\delta}$ show a sharp

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