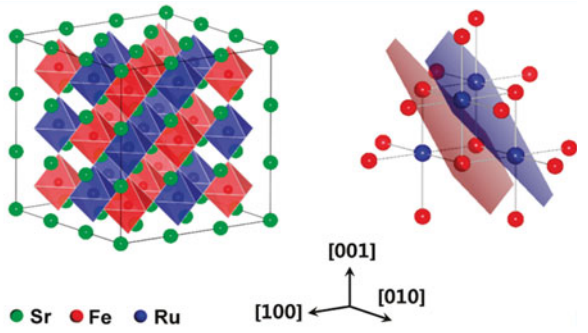
A (111)-ordered Sr_2FeRuO_6 superlattice displays room-temperature magnetic ordering

Oxide heterostructures displaying interfacial magnetic order have been the subject of much study but their use is currently limited by low magnetic ordering temperatures. In the May 5 online edition of *Chemistry of Materials* (DOI: 10.1021/cm200454z), S.-K. Kim at Seoul National University and his colleagues report on the growth of (111)-oriented Sr_2FeRuO_3 superlattices having a robust ordered-double-perovskite structure that display magnetic ordering up to 390 K.

The researchers managed to overcome thermodynamic barriers to (111)-oriented growth by using a thin $SrRuO_3$ buffer layer deposited on Ti^{4+}-terminated $SrTiO_3$ (111) as a template. They then deposited 55 alternating layers of $SrFeO_3$ and $SrRuO_3$ to build up a superlattice while maintaining precise structural and chemical control over each layer.

Using a combination of reflection high energy electron diffraction, x-ray diffraction, and transmission electron microscopy, the researchers confirmed the structure of the superlattices. They probed the temperature-dependent magnetization of the structure and found that it possesses a magnetic-ordering (ferromagnetic or ferrimagnetic) critical temperature (T_c) of ~390 K, more than double the T_c of isolated $SrRuO_3$ and $SrFeO_3$. They attribute this unusual behavior to band broadening and electron transfer that typically occur in ordered double perovskites, as well as ferromagnetic order stabilized by the addition of Ru^{5+} ions.



Ordered-double-perovskite structure of Sr_2FeRuO_3 shows stacking of Ru and Fe ions in (111) planes. Reprinted with permission from *Chem. Mater.* (May 5, 2011), DOI: 10.1021/cm200454z. ©2011 American Chemical Society.

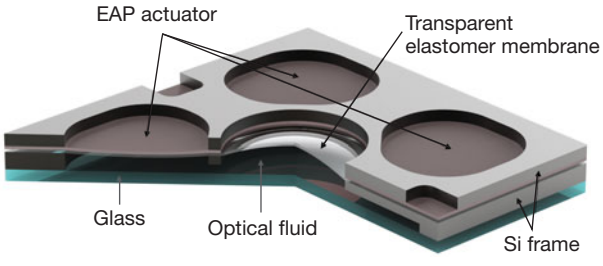
The researchers said that their (111)-ordered superlattice-growth method may be applied to the growth of different oxide systems to achieve new kinds of room-temperature electronic and magnetic ordering.

Steven Spurgeon

Polymer actuators focus a liquid microlens

Developing microlenses with focusing capability is becoming increasingly desirable for use in microimaging systems such as those found in mobile phone cameras. A flexible cavity filled with liquid forms a lens which can be deformed and focused simply by the movement of liquid into or out of the cavity. By using an electroactive polymer actuator to apply pressure to the liquid, a research team at Samsung Advanced Institute of Technology has fabricated tunable microlenses which operate at low voltages and can be microfabricated in large arrays.

In the May 15 issue of *Optics Letters* (DOI: 10.1364/OL.36.001920; p. 1920), S.T. Choi and co-workers describe their device based on a silicon frame sandwiched between the elastomer polydimethoxylsilane (PDMS) on one side and glass on the other. The silicon is shaped so as to form a 2.4 mm diameter central circle for the lens, linked to four surrounding reservoirs by microfluidic channels. These cavities are filled with a high refractive index optical liquid and then sealed using an ultraviolet curable adhesive. A film of the electroactive actuator poly(vinylidene fluoride-trifluoroethylene-chlorotrifluoroethylene) (1.5 μm thick) is laminated onto the PDMS face of the device, while leaving clear the lens. In order to enhance the response of the polymer at low voltages, further films are alternately layered with thin aluminum electrodes to form a multilayered actuator. A complete stack of 15 electrodes is connected vertically by depositing a post of aluminum into a laser-drilled hole.



Schematic diagram of the varifocal microlens, based on a liquid-filled elastomeric cavity. Reprinted with permission from *Opt. Lett.* **36** (10) 2011 (DOI: 10.1364/OL.36.001920; p. 1920). © 2011 The Optical Society.

Applying a driving voltage to the actuators caused them to depress the elastomer beneath them and force the fluid through the channels and into the lens cavity of the device. As a result, the elastomer over the lens is pushed out and the optical length of the cavity is altered. At 40 V, the combined force of the actuators on each of the four reservoirs induced a 37 μm displacement of the lens. The device was integrated into a mobile phone camera to demonstrate tunable fo-

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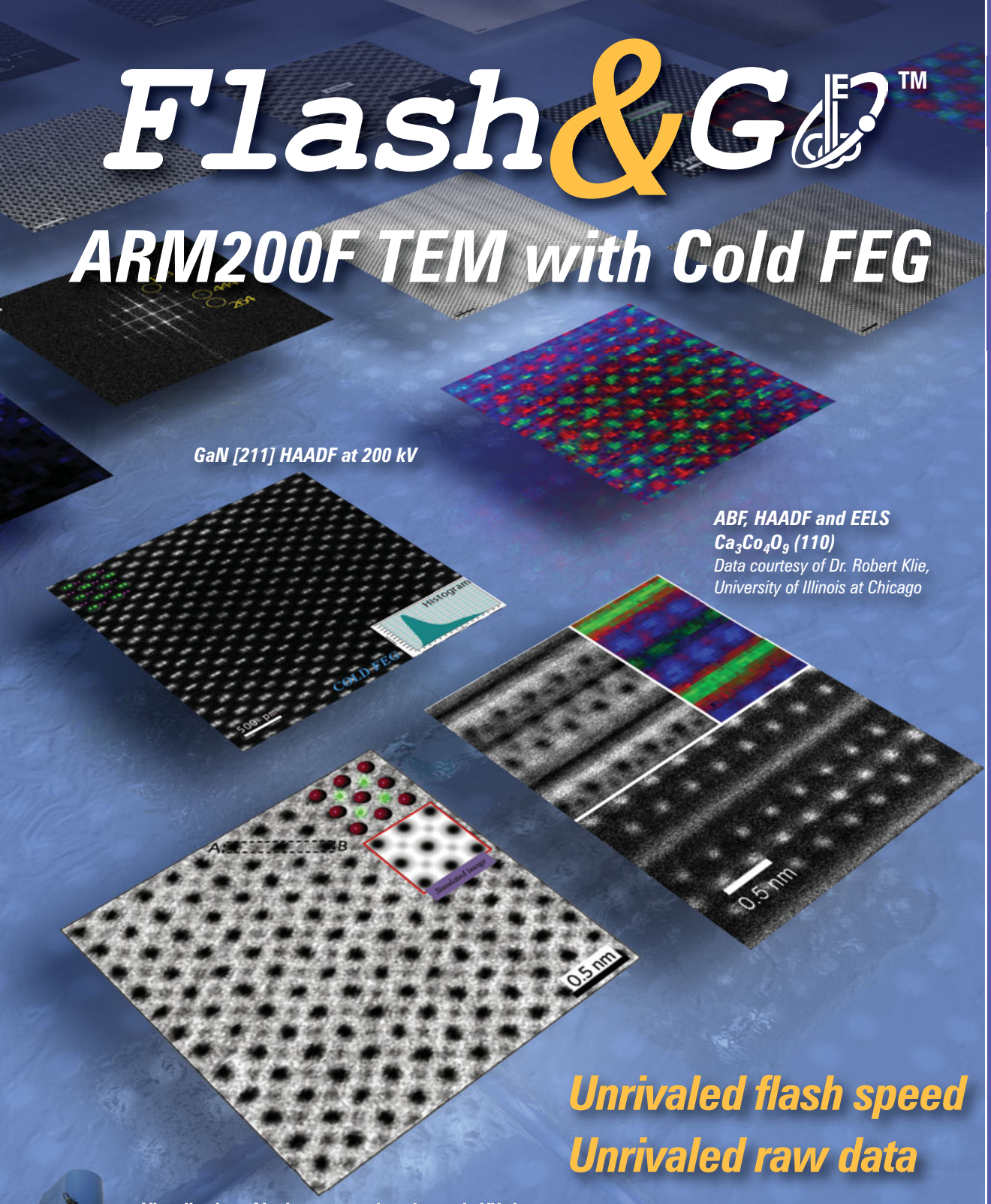

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Visualization of hydrogen atomic columns in YH_2 by ABF imaging (Y = red, H = green) *Data courtesy of Ryo Ishikawa and Dr. Eiji Abe (The University of Tokyo)*

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cusing, and clear images were taken with the lens focused to 10 cm and infinity.

The multilayering of the polymer actuator is an essential feature which enables it to operate at voltages compatible with hand-held electronics. Together with the fact that they can be easily microfabricated in wafer-sized arrays, these liquid lenses have considerable potential for use in commercial devices, according to the researchers.

Tobias Lockwood

$Bi_{12}TiO_{20}$ nanocrystals prepared by electrochemical synthesis exhibit excellent photocatalytic ability under visible light

Although titania (TiO_2) is a good photocatalyst, its use is limited to the ultraviolet range and thus cannot be used in the visible solar light range. $Bi_{12}TiO_{20}$ has emerged in recent years as a promising alternative that may be used in the visible range. However, current methods to synthesize $Bi_{12}TiO_{20}$ are not well-suited to prepare ultrafine, well-dispersed, crystalline nanoparticles that are desired for photocatalytic applications. Recent work from the China Building Materials Academy in Beijing has resulted in a new electrochemical route to prepare well-dispersed $Bi_{12}TiO_{20}$ nanocrystals.

Current solid-state synthesis and wet chemical methods used to prepare $Bi_{12}TiO_{20}$ require high temperature processing or special equipment that yield large-sized aggregated crystals which are at best sub-optimal for photocatalytic applications. Reporting in the May issue of the *Journal of the American Ceramic Society* (DOI: 10.1111/j.1551-2916.2011.04505.x; p. 1336), C. Gao, J. Ma, and co-workers prepared $Bi_{12}TiO_{20}$ nanoparticles by precipitation in an electrolytic solution using Bi and Ti plates as the anode and cathode, respectively. Adjusting the concentration of H_3PO_4 in the electrolyte caused a change in nanoparticle dispersion.

Electron microscopy revealed that a pure body-centered cubic (bcc) phase was formed in the absence of H_3PO_4 where the nanoparticles agglomerate into 2–3 μm spheres. However, increasing the concentration of H_3PO_4 increased the fraction of the face-centered cubic (fcc) phase with a concomitant weakening of the interparticle adhesion resulting in a well-dispersed $Bi_{12}TiO_{20}$ nanoparticle mixture of bcc and fcc phases.

UV-vis absorption spectra of the prepared samples revealed absorption onset wavelengths exceeding 500 nm, exhibiting good response in the visible light region. The $Bi_{12}TiO_{20}$ particles also efficiently degraded an RhB dye under visible light facilitated by the high specific surface area of the well-dispersed nanosized particles. Thus, electrochemical synthesis of $Bi_{12}TiO_{20}$ nanoparticles offers a promising new route to prepare photocatalysts that are responsive to solar light, according to the researchers.

Kaushik Chatterjee

Numerical simulations predict ultrasmall subwavelength plasmonic cavity

Plasmonic lasers (also called nanolasers), proposed about a decade ago, as well as other high-performance photonic devices, such as single-photon devices, require ultrasmall cavities. In contrast to diffraction-limited dielectric cavities, plasmonic cavities have resonant modes with subwavelength mode volumes. Although plasmonic lasing has been demonstrated, further mode-volume reduction is required for the high density integration of plasmonic devices. Toward this goal, S.-H. Kwon of Chung-Ang University in South Korea along with H.-G. Park and co-researchers at Korea University have proposed a novel plasmonic cavity and used numerical simulations to demonstrate mode volumes an order of magnitude smaller than previously achieved.

As reported in the June 1 issue of *Optics Letters* (DOI:10.1364/OL.36.002011; p. 2011), Kwon, Park, and co-researchers designed a plasmonic cavity consisting of a silver-covered, rectangular (100 nm × 200 nm) nanorod, composed of high- and low-index dielectric materials (refractive indices n of 3.4 and 1.5, respectively), atop a transparent sapphire substrate (see Figure 1). The researchers reasoned that surface plasmon polaritons (SPPs) can be efficiently excited at the nanorod–silver interface by optical pumping through the sapphire

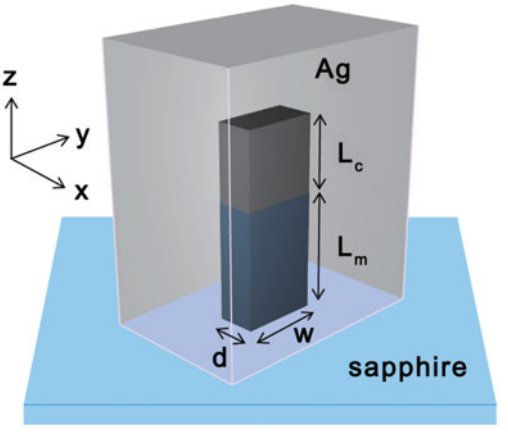

Figure 1. A schematic diagram of the surface plasmon polariton (SPP) cavity—a silver-covered dielectric nanorod consisting of a high-index material (dark grey) on top of a low index material (blue)—placed on a sapphire substrate.

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