material film and the SiO_2/Si interface. The researchers said that the interface causes this behavior in two ways. First, the interface reflects some of the PL radiation, producing constructive and destructive interference between the directly emitted and reflected radiation. The PL intensity increases (and lifetime decreases) for samples in which the thickness of the SiO_2 layer allows mostly constructive interference. The opposite is true when destructive interference predominates. Second, the interface causes a damped oscillatory fluctuation in the local density of the optical modes that, in turn, has the same effect on the PL intensity and lifetime. This semiconductor-interface-induced optical-mode density fluctuation has been predicted by quantum mechanical calculations and previously observed for single-atom emitters.

GREG KHITROV

Single-Phase $Ba_2Ti_9O_{20}$ Fabricated after Addition of 5% B_2O_3

The compound $Ba_2Ti_9O_{20}$ is known for its good microwave properties, including a high-dielectric constant. Synthesis of $Ba_2Ti_9O_{20}$ by solid-state reaction is a challenging procedure because of the likelihood of the formation of intermediate stable compounds and of decomposition in different phases. Different techniques have been developed to obtain single-phase $Ba_2Ti_9O_{20}$, including the use of solid-state additives, chemical methods such as sol-gel fabrication, and the addition of precursors. Among other additives, B_2O_3, known for improving dielectric properties and optimizing sintering conditions in other materials, is a common addition in electronic glass applications. For these reasons, it was chosen by a group of scientists from the National Taipei University of Technology and the National Taiwan Ocean University as a solid-state additive in the fabrication of $Ba_2Ti_9O_{20}$, as they described in the June issue of the *Journal of the American Ceramic Society*.

S.-F. Wang of Taipei and co-workers started the fabrication of $Ba_2Ti_9O_{20}$ from powders of 81.8% TiO_2 and 18.2% BaO. After mixing in methyl alcohol for 6 h, the powders were dried and then calcined at 1000°C for 8 h. At this point, x-ray diffraction (XRD) analysis detected two phases: $BaTi_4O_9$ and $BaTi_5O_{11}$. Powders were then mixed again with different additions of Ba_2O_3 in methyl alcohol for 8 h. Further mixing with 3.5 wt% of a 15% poly(vinyl alcohol) solution allowed the fabrication of disks that were later sintered at different temperatures for 6 h. A liquid-displacement method permitted the measurement of the density of the resulting materials. Powders with 5% addition of Ba_2O_3 showed a higher density after sintering at temperatures below 1100°C, as compared with the material without additive.

Results after differential thermal analysis show that the material with 5% Ba_2O_3 has an endothermic peak at 840°C. At this temperature, Ba_2O_3 forms a liquid eutectic that enhances the densification process. At temperatures higher than 1100°C, evaporation of Ba_2O_3 precludes the increasing densification, as compared with the material without Ba_2O_3 addition. Comparing results from XRD analysis, the material without Ba_2O_3 addition revealed the presence of $BaTi_4O_9$ and $Ba_2Ti_9O_{20}$. In the case of the material with 5% Ba_2O_3, only $Ba_2Ti_9O_{20}$ was detected after sintering at temperatures as low as 900°C.

For additions of up to 10% Ba_2O_3, XRD revealed the formation of $BaTi(BO_3)_2$ and TiO_2 after sintering at temperatures below 1200°C. At higher temperatures, $BaTi(BO_3)_2$ decomposed and its product $BaTiO_3$ combined with TiO_2 to form $Ba_2Ti_9O_{20}$.

SIARI S. SOSA

Low-Temperature 2D-to-3D Transition in Layered Metals Correlates with the Presence of Coherent Quasi-Particles within the Layers

The transition between metal and insulator is of particular interest when materials with reduced dimensionality exhibit two- or one-dimensional characters within a three-dimensional system. Using electronic-transport measurements and angle-resolved photoemission, researchers at Brookhaven National Laboratory, the University of Connecticut, Princeton University, and Osaka University have explored the behavior of 2D metals that change to 3D materials at low temperature and proposed new means for understanding this behavior. Their findings were described in the June 6, 2002, issue of *Nature*.

In their letter, T. Valla and co-workers suggest that the crossover from full to reduced dimensionality is correlated with the presence or absence of coherent quasi-particles within the layers of the material. The researchers studied the layered metallic materials $(Bi_{0.5}Pb_{0.5})_2Ba_3Co_2O_y$ and $NaCo_2O_4$ that become effectively 3D materials at low temperatures, below the crossover temperature of ~100–200 K.

The technique of angle-resolved photoelectron spectroscopy (ARPES) employed in this study has the advantage of directly measuring the single-particle spectral function that appears in the equation describing conductivity. It also is able to investigate deeper states, unlike transport probes, which may be crucial to understanding higher-temperature behavior. Valla and co-workers observed a dramatic correlation between dimensionality crossover and measured features of the spectral function measured by ARPES. A sharp quasi-particle peak is apparent in the low temperature 3D state and broadens and disappears as the temperature increases and the system becomes effectively 2D.

Although the researchers speculate that a variety of competing mechanisms may play greater or lesser roles in effecting the crossover to the 3D ground state, the proposed importance of coherent quasi-particles provides new insight into this phenomenon. Valla said, "The existence of quasi-particles has been at the core of our understanding of transport phenomena in solid-state materials for decades and the behavior observed in this work points toward the necessity of modifying the conventional picture."

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