and composition ranges where the α phase is stable. In compositions with 100% α phase, the grain-boundary phase is reduced as all of the additives can enter into the structure. Now, by using a novel stabilizing material, Lu_2O_3, a team of scientists from the Agency of Industrial Science and Technology (AIST) and the Fine Ceramics Research Association in Nagoya, Japan, have obtained a highly dense, transparent Lu-α-SiAlON ceramic.

As reported in the April issue of the *Journal of the American Ceramic Society* (p. 714), M.I. Jones and K. Hirao of AIST, H. Hyuga of the Fine Ceramics Research Association, and colleagues hot-pressed a mixture of Si_3N_4, Al_2O_3, AlN, and Lu_2O_3 at 1950°C and 40 MPa for 2 h in a 0.9 MPa nitrogen atmosphere. X-ray diffraction patterns of this material showed that only α-SiAlON was present. Both scanning and transmission electron microscopy observations revealed a fully dense, uniform microstructure of equiaxed grains, with a grain size of ~1 μm and with little or no grain-boundary phase present at triple points. Vickers hardness measurements using 98 N load gave results above 19 GPa, and indentation fracture using 98 N load gave a fracture toughness of ~2.5 MPa $m^{1/2}$. Four-point bend tests with inner and outer spans of 10 mm and 30 mm, respectively, and a crosshead speed of 0.5 mm/min gave a bending strength of 400 MPa.

Optical transmission measurements using spectrophotometry in the wavelength range of 350–800 nm were performed on 0.5-mm-thick samples. At 350 nm, transmission was ~35%, increasing with increasing wavelength. At ~500 nm, transmission was more than 60%, and for wavelengths larger than 600 nm, transmission was ~70%.

Similar measurements reported in the literature on β-SiAlON ceramics gave ~40% transmission maximum at ~4.5 μm wavelength, with low transmission in the visible region. The investigators attribute the high transparency of Lu-α-SiAlON to the lack of grain-boundary phases, lack of porosity, and the small uniform grain size. The investigators said that they will now study the mechanical properties of this material, which are expected to be better than the more commonly studied Y-stabilized SiAlON, at high temperatures.

SIARI SOSA

Nanostructured Biosensors Produced by Nanosphere Lithography

Biosensors rely on the principle of specific interactions between the sensor support and the biomolecule targeted. Thus, high control over the sensor-surface shape and functionality at the nanoscale is needed. Optical lithography can be used to generate patterned surfaces, but becomes complicated for feature sizes below 200 nm because of diffraction limits. Nanosphere lithography is an alternative method capable of producing nanotopography over large surface areas, as explained by A. Valsesia and a team of researchers at the Institute for Health and Consumer Protection, Ispra, Italy. As reported in *Nano Letters* (Web release date, May 8), the researchers produced polymeric nanoislands with biospecific chemical functionalities, combining plasma deposition and etching techniques with colloidal particle masking.

A polymer film of acrylic acid (PAA) was deposited on silicon wafers by plasma-enhanced chemical vapor deposition. The substrate was later covered by a monolayer of polystyrene particles, with an

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average diameter of 500 nm, by spin coating. The hydrophobic PAA coating of the substrates enabled the particles to be deposited without using a surfactant. Areas of up to 50 µm of polycrystalline polystyrene nanoparticles were observed.

The nanoparticles act as a nanomask during the etching process with oxygen. To achieve some nanodome top surface with PAA functionalities, the nanoparticles were not completely etched. The plasma treatment was stopped in time to leave some residual nanoparticles on top of the nanodomes. These nanoparticles were then removed by an ultrasound bath in water. Under atomic force microscopy and scanning electron microscopy studies, the resulting surface showed two-dimensional, crystalline, PAA truncated cones separated by substrate-like zones. Because the top of the truncated cones had not been exposed to the oxygen plasma, it retained the carboxylic functionalities of the polymer. Measurements from atomic force microscopy images showed flat plateaus of ~250 nm in diameter. Protein absorption experiments revealed that the molecules were selectively bound to the functional plateau of the domes, with no protein found in the surrounding matrix (Figure 1). The researchers anticipate applications for biosensor development because of the possibility of controlling the surface distribution of nanostructures in a macroscopic area of the devices.

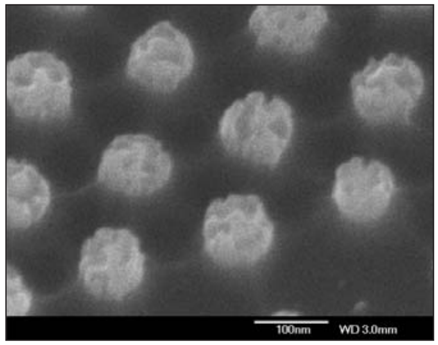

Figure 1. Field-emission gun scanning electron microscopy image of the BSA protein selectively bound on a polymer film of acrylic-acid dome top surface.

MARIA CORTALEZZI

Review Articles and Special Issues

Acta Materialia **52** (10) (June 7, 2004) contains D.J. Larson, A.K. Petford-Long, Y.Q. Ma, and A. Cerezo, "Information Storage Materials: Nanoscale Characterisation by Three-Dimensional Atom Probe Analysis," p. 2847.

Journal of Applied Physics **95** (11) (June 1, 2004) contains R.C. Ewing, W.J. Weber, and J. Lian, "Nuclear Waste Disposal—Pyrochlore ($A_2B_2O_7$): Nuclear Waste Form for the Immobilization of Plutonium and 'Minor' Actinides," p. 5949.

Low Temperature Physics **30** (5) (May 2004) contains S.V. Lubenets, V.D. Natsik, and L.S. Fomenko, "Plasticity and Strength of Metal Oxide High-Temperature Superconductors (Review)," p. 345.

Physics of the Solid State **46** (5) (May 2004) contains Yu.I. Golovin, "Magnetoplastic Effects in Solids," p. 789.

Applied Mechanics Reviews **57** (2) (March 2004) contains V.A. Lubarda, "Constitutive Theories Based on the Multiplicative Decomposition of Deformation Gradient: Thermoelasticity, Elastoplasticity, and Biomechanics," p. 95; R. Krueger, "Virtual Crack Closure Technique: History, Approach, and Applications," p. 109; and H. Irschik and H.J. Holl, "Mechanics of Variable-Mass Systems—Part 1: Balance of Mass and Linear Momentum," p. 145.

Solid State Electronics **48** (8) (August 2004) is a special issue on "Strained-Si Heterostructures and Devices."

Chaos: An Interdisciplinary Journal of Nonlinear Science **14** (2) (June 2004) contains a focus section on "Global Dynamics in Spatially Extended Mechanical Systems."

Journal of Applied Physics **95** (11) (June 1, 2004) contains a special section with papers from the 9th Joint Magnetism and Magnetic Materials Intermag Conference

Journal of Computing and Information Science in Engineering **4** (2) (June 2004) is a special issue on "Virtual Reality for Product Development."

Journal of Engineering Mechanics **130** (6) (June 2004) is a special issue on "Constitutive Modeling of Geomaterials."

Journal of Bridge Engineering **9** (3) (May/June 2004) contains a special section on "Steel Bridges."

Journal of Biomedical Optics **9** (3) (May 2004) contains a special section on "Biomedical Optics and Women's Health."

Journal of Performance of Constructed Facilities **18** (2) (May 2004) is a special issue on "Blast Mitigation and Design Against Terrorism."

IEEE Transactions on Device and Materials Reliability **4** (1) (March 2004) is a special issue containing selected papers from the 2003 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Physical and Failure Analysis of Integrated Circuits (IPFA).

Journal of Fluids Engineering **126** (2) (March 2004) contains papers from International Mechanical Engineering Congress 2002 in New Orleans, La., from the symposia on the "Rheology and Fluid Mechanics of Nonlinear Materials," "Advances in Processing Science," and "Electric and Magnetic Phenomena in Micro and Nano-Scale Systems."

Organic Electronics **5** (1–3) (March 2004) is a special issue containing papers from the European Materials Research Society symposium on "Current Trends in Crystalline Organic Semiconductors: Growth Modelling and Fundamental Properties."

News of MRS Members/Materials Researchers

Paul Alivisatos, Chancellor's Professor of Chemistry and Materials Science at the University of California, Berkeley, has been elected into the **National Academy of Sciences**.

Yoel Fink, Thomas B. King Assistant Professor of Materials Science at the Massachusetts Institute of Technology, has received the **National Academy of Sciences Award for Initiatives in Research** in recognition of his "pioneering contributions and ingenuity in the creative design and development of photonic materials and devices." The award, presented since 1981, was established by AT&T Bell Laboratories in honor of William O. Baker.

Edith Flanigen, a consultant for UOP, a joint venture between Union Carbide and Allied Signal, has been named to receive the **2004 Lemelson-MIT Lifetime Achievement Award** in recognition of her pioneering work in chemistry and materials science to help make petroleum refinement cleaner and safer.

Nick Holonyak, the John Bardeen Professor of Electrical and Computer Engineering and Physics at the University of Illinois, has been named to receive the **2004 Lemelson-MIT Prize for Inven-**

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