with identical structures—that is, identical diameters and chiralities—display different emission energies, although each individual emission line does match transitions observed in ensemble-averaged spectra. The researchers used low-energy Raman scattering attributed to the nanotube's radial breathing mode to verify that the source of the fluorescence was individual nanotubes. The researchers attribute the heterogeneous emission properties obtained from SWNTs with identical diameter and chirality values to localized defects and perturbations.

For moderate excitation energies (<70 kW cm^{-2}), time traces of the fluorescence of individual SWNTs showed constant amplitude for 100 s. The researchers said that by contrast both molecular dyes and individual semiconducting quantum dots exhibit fluorescence emission intermittencies or an on/off blinking behavior over very long time scales. The researchers conclude that "SWNTs have the potential to provide a stable, single-molecule infrared photon source with extremely narrow linewidth."

STEVEN TROHALAKI

Three-Phase Boundary Fuel-Cell Reactor Produces H_2O_2 at 93% Selectivity

Industrial production of hydrogen peroxide (H_2O_2) requires separation and distillation from a solution of alkylated anthraquinones (from crude oil) in a multistep procedure that consumes a lot of energy. For certain applications, a costly electrolysis process is used, but this option is not commonplace for high-scale production. Uses of H_2O_2 include water and wastewater treatment, bleaching of textiles and paper, food processing, and even odor control. To create a cost-effective and energy-efficient system suitable for large-scale production of H_2O_2, I. Yamanaka and his colleagues at the Tokyo Institute of Technology have designed a fuel-cell reactor with a three-phase boundary that overcomes the disadvantages of previous designs. With a three-phase boundary formed by gaseous O_2, aqueous electrolyte, and a solid porous cathode, this reactor reduces the chance of O_2 and H_2 coming into contact and exploding; it generates electricity along with H_2O_2.

As reported in the August 8 issue of *Angewandte Chemie*, both the cathode and anode were fabricated from hot-pressed vapor-grown carbon fiber and poly(tetrafluoroethylene) powder, adding a small amount of a carbon black material to the cathode and platinum black powder to the anode. Pure O_2 and H_2 are the starting gases, and titration against $KMnO_4$ determined the concentration of H_2O_2. A cation membrane separated the electrolyte compartment between the cathode and the anode into two sections, each one filled with NaOH. Diffusion of H_2O to the cathode compartment under stagnant conditions depleted the anode compartment and reduced the current density. Pumping NaOH continuously into the anode compartment helped stabilize the current density. Electrochemical measurements determined that the rate-controlling reaction was the reduction of O_2. Using this reactor, H_2O_2 selectivity based on H_2 or current efficiency based on the two-electron reaction is 93% after 2 h, the rate of formation is 2.0 mmol/h cm^2, the concentration is 7.0 wt%, and the current density is 100 mA/cm^2, similar to that obtained by electrolysis (80–120 mA/cm^2). By substituting O_2 for air, the current efficiency is 88% after 3 h, the rate of formation is 1.3 mmol/h cm^2, the concentration is 6.5 wt%, and the current density is 78 mA/cm^2, which is a slight decrease but still a good performance yet less expensive, representing an advantage for industrial-scale production.

SIARI SOSA

Single-Molecule Resistance Measured by Repeated Formation of Molecular Junctions

In the process of using individual molecules to create electronic circuits, the resistance level of a simple molecule like an alkane

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chain covalently attached to two electrodes is still a subject of debate. B. Xu and N.J. Tao from Arizona State University have measured the resistance of single molecules by repeatedly forming molecular junctions between a gold scanning tunneling microscope (STM) tip and a gold surface, as reported in the August 29 issue of *Science*.

The molecular junctions were created in a liquid cell by repeatedly moving a gold STM tip into and out of contact with the sample. In the first step, the formation of a chain of Au atoms was observed in pure solvents (toluene and water). The conductance of this chain decreased with increas-

Review Articles and Special Issues

Annals of Biomedical Engineering **31** (9) (October 2003) contains "Bioreactors for Cardiovascular Cell and Tissue Growth: A Review" by V. Barron, E. Lyons, C. Stenson-Cox, P.E. McHugh, and A. Pandit (p. 1017).

Applied Mechanics Reviews **56** (5) (September 2003) contains "Use of Conventional Optical Fibers and Fiber Bragg Gratings for Damage Detection in Advanced Composite Structures: A Review" by K.S.C. Kuang and W.J. Cantwell (p. 493) and "Recent Developments and Applications of Invariant Integrals" by Y.-H. Chen and T. J. Lu (p. 515).

Crystallography Reports **48** (5) (September 2003) contains "Magnetoplastic Effect: Basic Properties and Physical Mechanisms" by V.I. Alshits, E.V. Darinskaya, M.V. Koldaeva, and E.A. Petrzhik (p. 768); and "The Influence of Magnetic Effects on the Mechanical Properties and Real Structure of Nonmagnetic Crystals" by A.A. Urusovskaya, V.I. Alshits, A.E. Smirnov, and N.N. Bekkauer (p. 796).

Journal of Applied Physics **94** (8) (October 15, 2003) contains "Fluorescence Intensity Ratio Technique for Optical Fiber Point Temperature Sensing" by S.A. Wade, S.F. Collins, and G.W. Baxter (p. 4743).

Journal of Energy Resources Technology **125** (3) (September 2003) contains "Innovative Technologies for Managing Oil Field Waste" by J.A. Veil (p. 238).

Journal of Experimental and Theoretical Physics **97** (2) (August 2003) contains "Superconductivity in Doped Nondegenerate Insulators" by A.I. Agafonov and E.A. Manykin (p. 358) and "X-Ray Optical Activity: Applications of Sum Rules" by J. Goulon, A. Rogalev, F. Wilhelm, C. Goulon-Ginet, P. Carra, I. Marri, and Ch. Brouder (p. 402).

Journal of Microelectromechanical Systems **12** (4) (August 2003) contains "Surface Tension-Powered Self-Assembly of Microstructures—The State of the Art" by R.R.A. Syms, E.M. Yeatman, V.M Bright, and G.M. Whitesides (p. 387).

Journal of Vacuum Science & Technology B: Microelectronics and Nanometer Structures **21** (5) (September 2003) contains "Review of Trench and Via Plasma Etch Issues for Copper Dual Damascene in Undoped and Fluorine-Doped Silicate Glass Oxide" by D.L. Keil, B.A. Helmer, and S. Lassig (p. 1969).

Physics of the Solid State **45** (10) (October 2003) contains "Band Structure and Properties of Superconducting MgB_2 and Related Compounds (A Review)" by A.L. Ivanovskii (p. 1829).

Review of Scientific Instruments **74** (10) (October 2003) contains "Recent Advancements in Microwave Imaging Plasma Diagnostics" by H. Park, C.C. Chang, B.H. Deng, C.W. Domier, A.J.H. Donné, K. Kawahata, C. Liang, X.P. Liang, H.J. Lu, N.C. Luhmann Jr., A. Mase, H. Matsuura, E. Mazzucato, A. Miura, K. Mizuno, T. Munsat , Y. Nagayama, M.J. van de Pol, J. Wang, Z.G. Xia, and W-K. Zhang (p. 4239).

Reviews of Modern Physics **75** (4) (October 2003) contains "*Colloquium:* Saturation of Electrical Resistivity" by O. Gunnarsson, M. Calandra, and J.E. Han (p. 1085); "Hamiltonian Theories of the Fractional Quantum Hall Effect" by G. Murthy and R. Shankar (p. 1101); and "How to Detect Fluctuating Stripes in the High-Temperature Superconductors" by S.A. Kivelson, I.P. Bindloss, E. Fradkin, V. Oganesyan, J.M. Tranquada, A. Kapitulnik, and C. Howald (p. 1201).

Semiconductors **37** (10) (October 2003) contains "Modification of $Hg_{1-x}Cd_xTe$ Properties by Low-Energy Ions" by K.D. Mynbaev and V.I. Ivanov-Omskii (p. 1127).

IEEE Transactions on Semiconductor Manufacturing **16** (3) (August 2003) features a "Guest Editorial: Special Section on Compound Semiconductor Microelectronics Manufacturing: The Future is Here."

International Journal of Mass Spectrometry **229** (1–2) (September 2003) features "Mass Spectrometry Contributions to Nanosciences and Nanotechnology."

Journal of Biomedical Optics **8** (3) (July 2003) features a "Special Section on Multiphoton Microscopy."

Journal of Engineering Materials and Technology **125** (4) (October 2003) features a "Special Issue on Durability and Damage Tolerance of Heterogeneous Materials and Structures."

Journal of Microlithography, Microfabrication, and Microsystems **2** (4) (October 2003) features a "Special Section on Surface Micromachining" and a "Special Section on Micro-Optics for Photonic Networks."

Journal of Pressure Vessel Technology **125** (3) (August 2003) features a "Special Issue on Pressure Vessels Technology Applied to Gun Tubes."

Journal of Vibration and Acoustics **125** (4) (October 2003) features "Special Issue: The Contributions of Jørgen W. Lund to Rotor Dynamics."

Optical Engineering **42** (10) (October 2003) features a "Special Section on Advances in Optical Waveguide Engineering."

Applied Surface Science **219** (1–2)(October 15, 2003) contains "Proceedings of Applied Surface Modeling: Experiment, Theory and Simulations."

Cryogenics **43** (10–11) (October–November 2003) contains Proceedings of the Korea-Japan Joint Workshop 2002 on Applied Superconductivity and Cryogenics.

Infrared Physics & Technology **44** (5–6) (October–December 2003) contains Proceedings of the Workshop on Quantum Well Infrared Photodetectors.

Journal of Physics and Chemistry of Solids **64** (9–10) (September 2003) contains selected papers from the International Conference on Ternary and Multinary Compounds (ICTMC13).

Microelectronics Reliability **43** (9–11) (September–November 2003) contains Proceedings of the 14th European Symposium on Reliability of Electron Devices, Failure Physics, and Analysis.

Optical Materials **24** (1–2) (October–November 2003) contains Proceedings of the Fifth French-Israeli Workshop on Optical Properties of Inorganic Materials.

Solid-State Electronics **47** (10) (October 2003) contains papers selected from the 12th Workshop on Dielectrics in Microelectronics.

Thin Solid Films **442** (1–2) (October 1, 2003) contains selected papers from the 4th International Conference on Coatings on Glass.

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ing tip distance in a stepwise fashion, with a step value equal to the quantum of conductance, until the conductance value almost reached zero. Additional steps with step values of approximately integral multiples of 1/100 of the conductance quantum were observed for 1 mM 4,4′-bipyridine in a 0.1 M $NaClO_4$ water solution. The researchers attribute these additional conductance steps to the formation of junctions with one, two, three, and more molecules. In order to confirm that the conductance steps were caused by the formation of stable molecular junctions, a solution of 2,2′-bipyridine molecules was tested. In 2,2′-bipyridine, the positions of two nitrogen atoms prevent the molecule from simultaneously binding to two electrodes, and no conduction steps were observed. The same experiments were performed for hexanedithiol, octanedithiol, and decanedithiol molecules in toluene. The conductance showed stepwise behavior, but the step size was smaller than in the case of 4,4′-bipyridine because of the higher resistance of *N*-alkanedithiol molecules as compared with 4,4′-bipyridine. The researchers said that the resistance of *N*-alkanedithiol molecules corresponds well with the widely accepted model of electron tunneling through the molecule.

MAXIM NIKIFOROV

"Design Rules" of Silk Production Unraveled in Studies of *Bombyx mori* Cocoons

Traditionally, silk fibers produced by silkworms and spiders are harvested, disentangled, and then woven into fabrics. H.-J. Jin and D.L. Kaplan from Tufts University have begun to unravel the *in vitro* mechanism of silk processing in insects and spiders. As described in the August 28 issue of *Nature*, the researchers monitored the behavior of the silk fibroin solutions as a function of decreasing water content. Starting with the cocoons of the domestic silk moth *Bombyx mori*, the researchers "degummed" the cocoons to generate sericin-free fibroin fibers. The family of sericin proteins is hydrophilic and acts as the glue between fibroin fibers. The sericin in these aqueous fibroin solutions was substituted with polyethylene oxide (PEO). The silk fibroin and the PEO molecules preferentially vie for the water molecules in which the protein is dissolved. As the fibroin concentration is increased and the water content is lowered, micelles form first, ranging in diameter from 100 nm to 200 nm; subsequently, "globules" form as the water content is further decreased. Through scanning electron microscopy and atomic force microscopy, the researchers observed that these globules arise from phase separation between the hydrophilic and hydrophobic segments. Films of the fibroin aqueous solutions were cast and subsequently treated with methanol, physical shear, and stretching. The characteristics of the resulting silk structures depended critically upon the nature of the postprocessing.

The researchers describe a process that combines the primary sequence of the silk proteins and the biological environment of the gland during silk spinning to create silk fibers. These "design rules," said the researchers, apply to all silk proteins in terms of processing in aqueous environments, which can lead to materials engineering in aqueous systems of new silk-based materials with desired properties for potential applications in tissue engineering and biomaterials.

LARKEN E. EULISS

Carbon Nanocoil Supports Surpass Performance of Other Nanostructured Materials in Direct Methanol Fuel Cells

T. Hyeon of Seoul National University, Y.-E. Sung of Kwangju Institute of Science and Technology, and colleagues have developed carbon nanocoils as a catalyst support for the fabrication of direct methanol fuel-cell (DMFC) elec-

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