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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