Simple setup yields ‘nano-onions’

A simple new method yields high-quality “nano-onions,” according to professor Gehan Amaratunga, research associate Manish Chhowalla, and coworkers in the department of engineering at the University of Cambridge [Nature, 414, 506 (2001)]. The carbon particles could be useful as lubricants, Chhowalla says. The spherical nanoparticles, which range from 25 to 30 nm in diameter, have a C_{60} core surrounded by several carbon layers. Unlike other methods for generating carbon nanomaterials, this method does not require a vacuum system. The nanoparticles are generated by an arc discharge between two graphite electrodes submerged in water. The arc discharge is initiated by contacting a 5-mm pure graphite anode with a 12-mm cathode and generating a discharge voltage of 16 to 17 V and a discharge current of 30 amp. The nano-onions float on the water’s surface, whereas other products sink to the bottom of the beaker. The production method could be adapted for industrial use by increasing the size of the apparatus, increasing the arc current, chilling and circulating the water, and automatically replenishing the consumable graphite anode, according to the researchers.

Molecular traffic signal: two roles for one protein

Getting chemical signals across the membranes of cells is an intricate and well-choreographed process that requires not only exquisite selective receptors on the cell surface but a whole array of signaling partners within the cell that need to be in the right place at the right time. Marilyn G. Farqhar, professor of cellular and molecular medicine at the University of California, San Diego, and colleagues there and at Cornell University have identified a bifunctional protein that links these two activities [Science, 294, 1939 (2001)]. Their protein, called RGS-PX1, helps regulate transduction of a chemical signal into a cell by binding to one subunit of three-part G-protein signaling complex, thereby accelerating its inactivation by hydrolysis. (RGS stands for regulator of G-protein signaling.) Another portion of the protein—the PX part—delays the movement of another component of the cell-signaling machinery into endosomes, where it’s degraded. “The presence of both activities in one molecule makes RGS-PX1 an ideal bridge between G-protein signaling and regulation of vesicular trafficking,” the researchers conclude.

Crystal engineering

Systematic changes to molecular components can change crystal structures in unpredictable ways, but Michael D. Ward and coworkers at the University of Minnesota have been able to meet that crystal engineering challenge. Previously, they made host frameworks constructed of guanidinium and organodisulfonate ions in which the organic portion of the disulfonate ion forms a “pillar” that supports inclusion cavities. Now, by incorporating a “banana-shaped” pillar, they can force the framework into a crystal symmetry with ordered polarity, a necessary condition for many technologically important properties [Science, 294, 1907 (2001)]. “We used molecular symmetry of the molecule to force the banana-shaped pillars to all point in the same direction in these accordion-folded architectures,” Ward says. “That actually makes the host polar, because all the bananas point in the same direction.” The guest molecules, therefore, align in a single direction. By careful selection of the guest molecules, the researchers are able to make materials that can double the frequency of light.

H₂ a clue to a soggy ancient Mars?

The Far Ultraviolet Spectroscopic Explorer, launched into space two years ago, has detected molecular hydrogen on Mars [Science, 294, 1914 (2001)]. Scientists predicted the molecule’s presence 30 years ago, but telescopes hadn’t been sensitive enough to detect it until now. This discovery allows physicists Vladimir A. Krasnopolsky at Catholic University of America in Washington, D.C., and Paul D. Feldman at Johns Hopkins University to infer that Mars may have once contained an enormous amount of water—even more, proportionally, than Earth. Comparing values for H₂ on Mars and its deuterated counterpart, HD, and using an atmospheric model developed by Krasnopolsky, the authors calculated the rates at which these two species escape from the atmosphere into space. They then used those values to help reconstruct Mars’s ancient water content. The H₂ measurement also supports models that explain the stability of the planet’s mostly CO₂ atmosphere. These models include a series of reactions in the martian atmosphere involving, among other things, H₂O and H₂, which split apart and react with CO and O, turning them into CO₂.

SCIENCE & TECHNOLOGY ROUNDPUP

- **Using the Hubble Space Telescope**, astronomers have for the first time directly observed the atmosphere of a planet outside our solar system. They detected sodium in the planet’s atmosphere when it passed in front of star HD 209458.

- **A peptide designed to fold into the coiled coil motif** will still adopt that ropelike structure when the leucine residues at its core are replaced by hexafluoroleucines, according to Krishna Kumar and coworkers at Tufts University [J. Am. Chem. Soc., 123, 11815 (2001)]. The two types of proteins prefer not to coil up together, however, and sort themselves into bundles with all strands either fluorinated or nonfluorinated.

- **Minocycline may have potential as a treatment for Parkinson’s disease**. In mice, the antibiotic prevents the brain damage caused by a toxin used to reproduce the effects of the disease [Proc. Natl. Acad. Sci. USA, 98, 14669 (2001)].