Fullerene helps synthetic diamonds grow

The World Series may have brought an end to the baseball season, but buckyball fans still have plenty of diamond action. Most recently, researchers fascinated by this 60-carbon spherical molecule and its larger all-carbon cousins, called fullerenes, have used fullerenes to make diamond films and tiny carbon needles.

In an upcoming report in APPLIED PHYSICS LETTERS, scientists at Northwestern University in Evanston, Ill., describe a technique for making diamond films on silicon – an approach in which a thin layer of fullerenes increases diamond formation by almost 10 orders of magnitude over untreated silicon surfaces. In addition, the researchers suggest that the arrangements of carbon atoms in any starting material may determine how well the material promotes diamond growth.

"[The results] will throw some light on how diamonds nucleate," comments John C. Angus, a chemical engineer at Case Western Reserve University in Cleveland.

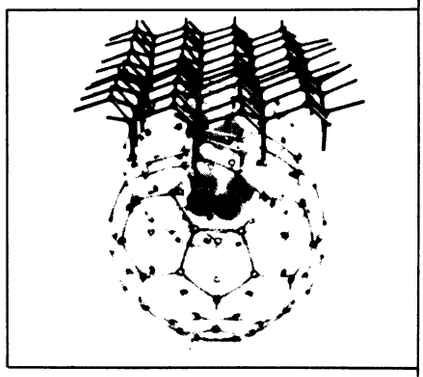
Despite considerable progress in making diamond films during the past five years (SN: 8/4/90, p.72), scientists lack good methods for covering large surfaces cheaply and completely, says Robert P.H. Chang of Northwestern. Until now, diamond-makers had to rub diamond powder or paste onto a surface first. Scientists have tried using graphite or organic molecules, but nothing worked as well as bits of diamond. So "up until now, there was no way to massively nucleate diamonds," Chang says.

It turns out, however, that the 70-carbon fullerene works as well as diamond paste, says Manfred M. Kappes, who works with Chang in making the diamond films. Also, one can "make patterns of diamonds because you can put [C_{70}] exactly where you want [on a surface]," he adds.

To make their film, the Northwestern researchers first coat silicon with the fullerene. Then they nick these carbon cages with fast-moving, positively charged carbon and hydrogen ions. "We've converted the C_{70} so it has parts of its surface that look like little pieces of diamond," Kappes explains. As a result, the ragged fullerene carbons that hang free can link up with free-floating carbon atoms and prompt deposition of the diamond crystal.

"Fullerenes might be a way of getting a lot of very closely spaced nucleation sites," Angus says. Chang hopes to identify carbon-based molecules with the geometry necessary to produce single-crystal diamond layers.

Japanese materials scientists have focused on a different sort of carbon molecule. Sumio Iijima of Fundamental Research Laboratories at NEC Corp. in Tsukuba, Japan, examined the carbon material that stayed stuck to the negative electrode typically used in making fullerene-filled soot. With a transmission electron microscope, he discovered that those needlelike specks consist of nested graphite tubes. The needles grew to a length of 1 micrometer and contained up to 50 tubes, Iijima reports in the Nov. 7 NATURE. The tubes grow so that they exhibit the same spacing as exists between the carbon layers in graphite, Iijima notes.



Shengzhong Liu/Northwestern Univ.

NATURE

Top: Model shows two fullerenes, with a flat diamond film growing on top. Right: Electron micrograph shows cross section of nested and capped fullerene tubes.

"It's not a scroll; it's straws inside straws," comments Mildred Dresselhaus, a physicist at the Massachusetts Institute of Technology in Cambridge. In August, she described a theoretical fullerene fiber similar to the ones now observed by Iijima. The fibers probably start off as buckyball spheres that develop a defect as they form and so grow into cylinders, she says. However, no one yet knows the exact arrangement of atoms in the fullerene-like tubes and, consequently, whether these tubes fit the definition of a true fullerene.

Scientists expect that fullerene fibers will be stronger than other carbon fibers and that these tubes might make good containers for holding other atoms. "[The fiber] ought to have very few defects, so it ought to have good mechanical properties," says Dresselhaus. – *E. Pennisi*

Marked questions on elderly depression

The majority of people aged 65 or older struggling to cope with moderate to severe depression go undiagnosed and untreated, warns a consensus statement issued last week by a 14-member panel of mental health clinicians and researchers. This neglect persists largely because many elderly individuals and many primary-care physicians regard depression as a normal part of aging, the panel concludes.

Social and physical problems also complicate the diagnosis and treatment of depression in the elderly, notes the panel, convened by the National Institutes of Health in Bethesda, Md.

"The system of care currently provided to elderly depressed persons is inadequate, fragmented and passive," asserts panel chairman Arnold J. Friedhoff, a psychiatrist at New York University School of Medicine in New York City.

Unfortunately, the same adjectives apply to the current state of research on the nature, course and treatment of depression among the elderly, which left the panel with important unanswered questions that elicited an urgent plea for more and better studies of older adults.

Problems begin with the definition of severe or "major" depression, a diagnosis derived from symptoms seen in people between 20 and 60 years of age. Some clinicians now suspect that these symptoms – including hopelessness, loss of interest in all activities, disturbances of sleep and appetite, and dulled concentration – may not accurately diagnose severe depression as experienced by the elderly, says panelist Kathleen R. Merikangas, a psychologist at Yale University School of Medicine.

For instance, depressed elderly people usually complain about a discrete medical illness and not depression's "classic" symptoms. In addition, depression may create an even greater risk of suicide in the elderly than in younger individuals. And unlike younger adults, elderly suicide victims usually have no history of suicide attempts or substance abuse, and often use guns or other violent means to end their lives.

Despite diagnostic uncertainties, the panel estimates that recurring bouts of severe depression afflict 3 percent of the elderly in the United States at any time, with another 15 percent sustaining "clinically significant" symptoms that fall short of full-blown depression. About one-quarter of the 1.3 million elderly living in U.S. nursing homes suffer from severe depression, the panel contends.

Antidepressant drugs known as tricyclics (which do not include the currently popular Prozac) and electroshock therapy have attracted the most scientific

attention as treatments for depression in the elderly. Tricyclics ease depression – but usually do not wipe away all symptoms – in about 60 percent of the people over age 65 studied, the panel says. However, side effects, such as lowered blood pressure and weight gain, may cause many of those given tricyclics to stop taking the drugs, the report says.

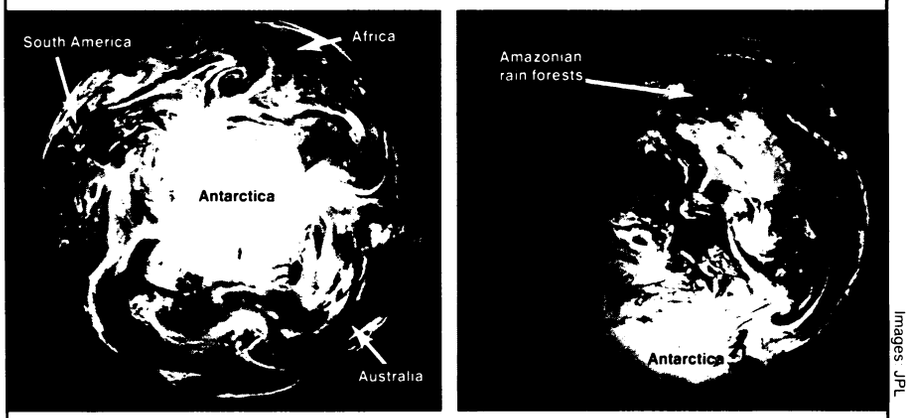
The depressed elderly get the bulk of electroshock therapy in the United States. The treatment provides short-term relief from depression, but relapses occur frequently once a series of electroshock sessions ends, the panel says. Moreover, people of advanced age have an increased risk of memory problems and confusion following electroshock.

Little research exists on psychosocial treatments for elderly people with depression, such as various forms of psychotherapy and outreach programs run by senior centers and other community programs. Combinations of biological and psychosocial treatments have not received any study, the panel observes.

Some researchers feel the paucity of research prevents any consensus on treatment. "All the research is weak," says psychologist Linda Teri of the University of Washington School of Medicine in Seattle, who did not sit on the panel. "Psychosocial research isn't necessarily weaker than biological research."

– B. Bower

Flyby: The world according to Galileo



Images JPL

Two newly released photographs reveal earthly details never before imaged from space. The photos were taken last December by the Galileo craft as it took its first swing past our planet on the way to a 1995 rendezvous with Jupiter.

The image at left offers an unprecedented view of the entire Antarctic continent as seen from above the South Pole. Researchers produced it by combining photographs taken through broad-band filters in green, red and near-infrared light. The reddish tinge indicates vegetation growing on several land areas, including South America and Australia. The varying intensities of blue-green demonstrate the different absorption properties of frozen water in glaciers, snow and clear ice, previewing Galileo's ability to distinguish similar features on some of Jupiter's chilly satellites. For example, sunlight reflected from ice paints parts of Antarctica a deep blue-green, while snow imparts a fainter hue of the same color. Glaciers form a blue-green fringe at the icy continent's lower right border.

In the image at right, centered on South America, scientists used a different set of filters to highlight features relevant to climate change. Deep red represents vegetation, most notably the Amazonian rain forests, while pink denotes a feature never before photographed from space: water vapor inside moist, low-lying clouds. (High-altitude clouds lack water vapor and appear white in the photo.) Galileo's ability to "see" water vapor stems from the use of three special filters – one red and two infrared – that transmit only a narrow range of wavelengths.

If weather satellites used similar filters to detect moist clouds, researchers could more accurately monitor the development and movement of storm systems, says W. Reid Thompson of Cornell University in Ithaca, N.Y. He released the images last week at a meeting of the American Astronomical Society's Division for Planetary Sciences in Palo Alto, Calif.

Warmth doth stretch Antarctica's tongues

It seems as obvious as an ice cube in a glass of water. When greenhouse gases in the atmosphere warm the Earth's climate, Antarctica's glaciers should melt around the edges and shrink in size.

But glacial ice does not behave so simply. New evidence suggests that during warmer times in the past, Antarctica's icy fringes have stuck out even farther than they do today, according to Eugene W. Domack from Hamilton College in Clinton, N.Y., and colleagues from the University of Arizona and the Geological Survey of Japan. "What this says is that under warmer conditions, the Antarctic glaciers would expand rather than melt and recede," says Domack.

The team reached this conclusion after studying sediments from three sites near outlet glaciers, which carry ice from East Antarctica's interior into the sea. The three sites all sit offshore from ice shelves or smaller ice tongues, aprons of glacial ice that extend into the ocean.

Domack and his co-workers used radiocarbon techniques to date changes in the sediments corresponding to ice advances or retreats. Certain layers of the sediments contain pebbles and ground-up rocks – recording a time when the ice reached far out over the ocean. In contrast, other layers hold the remains of marine algae from a time when the ice edge had retreated, leaving these sites covered by open water.

In the November GEOLOGY, the researchers report that ice shelves and tongues had reached their greatest extent between 7,000 and 4,000 years ago – a time when global temperatures were about 1°C or 2°C warmer than they are today. Since then, the ice edge has retreated at these three sites.

Domack thinks that the warmer climate 7,000 years ago caused the extension of outlet glaciers. That theory dovetails with recent research on snowfall in the Antarctic, which suggests that a modest hike in air temperatures could increase the ice volume on that continent. As air temperatures rise, the atmosphere can hold more water vapor; hence, more snow would fall over Antarctica. Additional snow falling on the outlet glaciers could cause them to extend farther out over the water, says Domack.

The same does not hold true for all glaciers, however. Ice in warmer locations lies closer to the melting point than does Antarctic ice. So any global warming should cause these less stable glaciers to retreat, Domack says.

Mark F. Meier, a glaciologist with the University of Colorado at Boulder, believes Domack and his colleagues must collect more evidence from other sites around Antarctica to prove their case. "[Their theory] may be right, but I'd hate to go to court with it," he says.

The behavior of outlet glaciers can ripple far beyond Antarctica. If these ice shelves and tongues extend in the future, they can raise global sea levels, says Meier. Conversely, increased precipitation in the interior of Antarctica pulls moisture out of the ocean, slowing the rise in sea level. Because scientists do not know which of these two processes will outweigh the other in Antarctica, they remain unsure how quickly global sea levels will rise over the next century, says Terence J. Hughes of the University of Maine, Orono.

– R. Monastersky