

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.

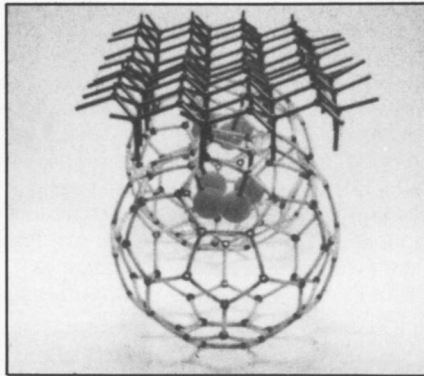
It turns out, however, that the 70-carbon fullerene works as well as diamond paste, says Manfred M. Kappes, who works with Chang in making the diamond films. Also, one can "make patterns of diamonds because you can put $[C_{70}]$ exactly where you want [on a surface]," he adds.

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.

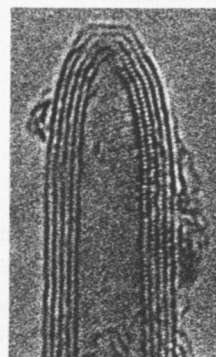
"Fullerenes might be a way of getting a lot of very closely spaced nucleation sites," Angus says. Chang hopes to identify carbon-based molecules with the geometry necessary to produce single-crystal diamond layers.

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 microme-



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.



ter 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.

"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