'Buckypaper': stronger than steel, harder than diamonds

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Working with a material 10 times lighter than steel - but 250 times stronger - would be a dream come true for any engineer. If this material also had amazing properties that made it highly conductive of heat and electricity, it would start to sound like something out of a science fiction novel. Yet one Florida State University research group, the Florida Advanced Center for Composite Technologies (FAC2T), is working to develop real-world applications for just such a material.

Ben Wang, a professor of industrial engineering at the Florida A&M University-FSU College of Engineering, serves as director of FAC2T (www.fac2t.eng.fsu.edu), which works to develop new, high-performance composite materials, as well as technologies for producing them.

Wang is widely acknowledged as a pioneer in the growing field of nano-materials science. His main area of research, involving an extraordinary material known as "buckypaper," has shown promise in a variety of applications, including the development of aerospace structures, the production of more-effective body armor and armored vehicles, and the construction of next-generation computer displays. The U.S. military has shown a keen interest in the military applications of Wang's research; in fact, the Army Research Lab recently awarded FAC2T a $2.5-million grant, while the Air Force Office of Scientific Research awarded $1.2 million.

"At FAC2T, our objective is to push the envelope to find out just how

strong of a composite material we can make using buckypaper," Wang said. "In addition, we're focused on developing processes that will allow it to be mass-produced cheaply."

Buckypaper is made from carbon nanotubes - amazingly strong fibers about 1/50,000th the diameter of a human hair that were first developed in the early 1990s. Buckypaper owes its name to Buckminsterfullerene, or Carbon 60 - a type of carbon molecule whose powerful atomic bonds make it twice as hard as a diamond. Sir Harold Kroto, now a professor and scientist with FSU's department of chemistry and biochemistry, and two other scientists shared the 1996 Nobel Prize in Chemistry for their discovery of Buckminsterfullerene, nicknamed "buckyballs" for the molecules' spherical shape. Their discovery has led to a revolution in the fields of chemistry and materials science - and directly contributed to the development of buckypaper.

Among the possible uses for buckypaper that are being researched at FAC2T:

… If exposed to an electric charge, buckypaper could be used to illuminate computer and television screens. It would be more energy-efficient, lighter, and would allow for a more uniform level of brightness than current cathode ray tube (CRT) and liquid crystal display (LCD) technology.

… As one of the most thermally conductive materials known, buckypaper lends itself to the development of heat sinks that would allow computers and other electronic equipment to disperse heat more efficiently than is currently possible. This, in turn, could lead to even greater advances in electronic miniaturization.

… Because it has an unusually high current-carrying capacity, a film made from buckypaper could be applied to the exteriors of airplanes.

Lightning strikes then would flow around the plane and dissipate without causing damage.

… Films also could protect electronic circuits and devices within airplanes from electromagnetic interference, which can damage equipment and alter settings. Similarly, such films could allow military aircraft to shield their electromagnetic "signatures," which can be detected via radar.

FAC2T "is at the very forefront of a technological revolution that will dramatically change the way items all around us are produced," said Kirby Kemper, FSU's vice president for Research. "The group of faculty, staff, students and post-docs in this center have been visionary in their ability to recognize the tremendous potential of nanotechnology. The potential applications are mind-boggling."

FSU has four U.S. patents pending that are related to its buckypaper research.

In addition to his academic and scientific responsibilities, Wang recently was named FSU's assistant vice president for Research. In this role, he will help to advance research activities at the College of Engineering and throughout the university.

"I look forward to bringing researchers together to pursue rewarding research opportunities," Wang said. "We have very knowledgeable and talented faculty and students, and I will be working with them to help meet their full potential for advancement in their fields."

Source: Florida State University (By Barry Ray)