Chevron and Stanford team up to develop nanoscale diamondoids

August 2 2006

Stanford and Chevron MolecularDiamond Technologies have teamed up to develop a novel class of nanomaterials derived from petroleum. Diamondoids—essentially diamond molecules—may find application in displays, sensors, hydrogen membranes for fuel cells and more.

Stanford professors leading the four-year research initiative with $1.2 million from Chevron Technology Ventures LLC are Co-Directors Zhi-Xun Shen (Departments of Applied Physics and Physics and the Stanford Synchrotron Radiation Laboratory) and Nick Melosh (Department of Materials Science and Engineering), with Hari Manoharan (Department of Physics).

"Diamondoids are exciting materials as they have the novelty of both diamond and nanostructures," says Shen, director of Stanford's Geballe Laboratory for Advanced Materials. "They provide new opportunities for scientific discoveries and technological applications over a wide range of disciplines. Judging from the revolutionary progress during the last decade in other novel carbon nanomaterials, namely the fullerenes and the nanotubes, we are excited about the diamondoids. The breakthrough by Chevron researchers in isolating diamondoids in large quantity from petroleum makes it possible for in-depth scientific exploration and large-scale applications."

Since 2003, scientists at Chevron MolecularDiamond Technologies have scaled up production of diamondoids to create a sufficient quantity for advanced application research and development.

"Nanoscience and nanotechnology are important new research areas that attract national attention, as reflected in the federal nanoscience initiative," says Arthur Bienenstock, Stanford's vice provost and dean of research and graduate policy. "The collaboration between Stanford and Chevron is an example of a university-industry partnership to advance this research."

Says Don Paul, Chevron Corp. vice president and chief technology officer: "Diamondoids represent a totally new class of nanomaterials and the first time that petroleum has been used in the development of such materials. This collaboration with Stanford and its world-class research teams will significantly accelerate our knowledge of diamondoids and unlock their potential."

That potential resides within a small package. Each diamondoid is less than a billionth of a billionth of a carat in size, says Frederick Lam, business development director for Chevron MolecularDiamond Technologies, which is a unit of Chevron Technology Ventures LLC, a wholly owned subsidiary of Chevron Corp.

"Diamondoids derived from petroleum have the potential to affect multiple industries such as energy, electronics, biopharmaceuticals, even consumer goods," Lam says. "And because MolecularDiamond Technologies is a part of a major petroleum company we have the advantage of a more reliable, higher quality supply compared to traditional sources of nanomaterials."

Says Dana Flanders, president of Chevron Technology Ventures LLC: "The Stanford-Chevron program will significantly facilitate our goals to better understand diamondoids and may help over the longer term to develop commercial applications, particularly in the opto-electronic area."

Known as the Stanford-Chevron Program for Diamondoid Nanoscience, the initiative will focus on several efforts. Research led by Shen to understand the fundamental electronic properties of diamondoids could lead to their use in electronic applications for the computer industry. Efforts to image individual diamondoid molecules and probe them electronically with the scanning electron microscopy technology are being directed by Manoharan. And Melosh is guiding work to create a variety of self-assembled monolayers and other methods to grow oriented crystals on top of monolayers.

"This program will leverage expertise of both Chevron and Stanford," Melosh says. "We believe the initial funding from Chevron will help us to jump start our research. This will attract more support, including support from federal agencies, for substantial activities in this new area."

Source: Stanford University