Adding Nanotubes Makes Ordinary Materials Absorb Vibration

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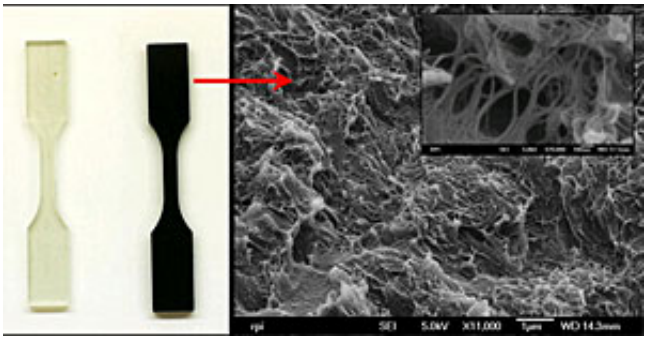

From left to right, an untreated sample of polymer material, the new nano-composite, and a scanning electron microscopy image showing the nanotubes dispersed in the polymer resin. Credit: Rensselaer/Koratkar

A new study suggests that integrating nanotubes into traditional materials dramatically improves their ability to reduce vibration, especially at high temperatures. The findings could pave the way for a new class of materials with a multitude of applications, from high-performance parts for spacecraft and automobile engines, to golf clubs that don't sting and stereo speakers that don't buzz.

The materials, developed by researchers at Rensselaer Polytechnic Institute, are described in the Feb. 8 issue of the journal *Nano Letters*.

Nanocomposites don't suffer from the same weight and volume penalties as current polymeric damping materials, but the new findings point to

another important advantage, according to Nikhil Koratkar, associate professor of mechanical, aerospace, and nuclear engineering at Rensselaer and lead author of the paper. “Traditional damping polymers perform poorly at elevated temperatures,” he says. “Our new materials provide excellent damping at high temperatures, suggesting that these nanocomposites show great potential for a variety of applications in aircraft, spacecraft, satellites, automobiles, and even sensors for missile systems — basically any structure that is exposed to vibration.”

Though much of the research focus has been on improving the strength and stiffness of nanomaterials, Koratkar and his coworkers have directed their attention to another important property: damping, or the ability of a material to dissipate energy. They have found that dispersing nanotubes throughout traditional materials creates new composites with vastly improved damping capabilities. And they have also shown for the first time that these damping properties are enhanced as the temperature increases.

Carbon nanotubes are made from graphite-like carbon, where the atoms are arranged like a rolled-up tube of chicken wire. They have enticed researchers since their discovery in 1991, offering an impressive combination of high strength and low weight, but few commercial applications have resulted in the intervening years, according to Koratkar.

The new materials could be extremely useful for any kind of space application, because temperatures swing wildly from very hot in the day to very cold at night, Koratkar notes. And he expects to use them in the diaphragms of loud speakers to help improve sound quality by reducing the buzz associated with high bass levels.

The sporting goods market is also an especially promising outlet, particularly for golf clubs and tennis racquets. “Manufacturers want

tennis racquets and golf club shafts to be light and stiff, but without the annoying sting that comes from a bad shot," Koratkar says.

Pulickel Ajayan, the Henry Burlage Professor of Materials Science and Engineering at Rensselaer and a world-renowned expert in fabricating nanotube materials, collaborated with Koratkar on this project, and two other Rensselaer researchers were involved with the research: Jonghwan Suhr, a post-doctoral researcher in mechanical, aerospace, and nuclear engineering; and Wei Zhang, a graduate student in aeronautical engineering.

Source: Rensselaer Polytechnic Institute