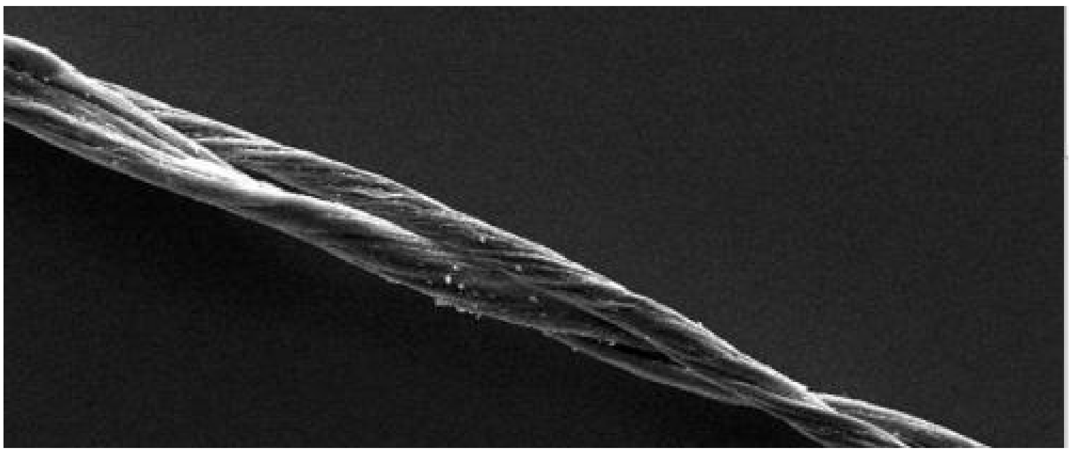
PHYS ORG

Nanocables light way to the future: Researchers power line-voltage light bulb with nanotube wire

September 7 2011



A power cable made entirely of iodine-doped double-walled carbon nanotubes is just as efficient as traditional power cables at a sixth the weight of copper and silver, according to researchers at Rice University. (Credit: Yao Zhao/Rice University)

(PhysOrg.com) -- Cables made of carbon nanotubes are inching toward electrical conductivities seen in metal wires, and that may light up interest among a range of industries, according to Rice University researchers.

A Rice lab made such a cable from double-walled carbon nanotubes and powered a fluorescent light bulb at standard line voltage -- a true test of the novel material's ability to stake a claim in energy systems of the future.

The work appears this week in the Nature journal *Scientific Reports*.

Highly conductive nanotube-based cables could be just as efficient as traditional metals at a sixth of the weight, said Enrique Barrera, a Rice professor of mechanical engineering and materials science. They may find wide use first in applications where weight is a critical factor, such as airplanes and automobiles, and in the future could even replace traditional wiring in homes.

The cables developed in the study are spun from pristine nanotubes and can be tied together without losing their conductivity. To increase conductivity of the cables, the team doped them with iodine and the cables remained stable. The conductivity-to-weight ratio (called specific conductivity) beats metals, including copper and silver, and is second only to the metal with highest specific conductivity, sodium.

Yao Zhao, who recently defended his dissertation toward his doctorate at Rice, is the new paper's lead author. He built the demo rig that let him toggle power through the nanocable and replace conventional copper wire in the light-bulb circuit.

Zhao left the bulb burning for days on end, with no sign of degradation in the nanotube cable. He's also reasonably sure the cable is mechanically robust; tests showed the nanocable to be just as strong and tough as metals it would replace, and it worked in a wide range of temperatures. Zhao also found that tying two pieces of the cable together did not hinder their ability to conduct electricity.

The few centimeters of cable demonstrated in the present study seems short, but spinning billions of nanotubes (supplied by research partner

Tsinghua University) into a cable at all is quite a feat, Barrera said. The chemical processes used to grow and then align nanotubes will ultimately be part of a larger process that begins with raw materials and ends with a steady stream of nanocable, he said. The next stage would be to make longer, thicker cables that carry higher current while keeping the wire lightweight. "We really want to go better than what copper or other metals can offer overall," he said.

The paper's co-authors are Tsinghua researcher Jinquan Wei, who spent a year at Rice partly supported by the Armchair Quantum Wire Project of Rice University’s Smalley Institute for Nanoscale Science and Technology; Robert Vajtai, a Rice faculty fellow in mechanical engineering and materials science; and Pulickel Ajayan, the Benjamin M. and Mary Greenwood Anderson Professor of Mechanical Engineering and Materials Science and professor of chemistry and chemical and biomolecular engineering.

More information: www.nature.com/srep/2011/11090 … /full/srep00083.html

Provided by Rice University