Sweet nanotech batteries: Nanotechnology could solve lithium battery charging problems

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Nanotechnology could improve the life of the lithium batteries used in portable devices, including laptop computers, mp3 players, and mobile phones. Research to be published in the Inderscience publication - *International Journal of Nanomanufacturing* - demonstrates that carbon nanotubes can prevent such batteries from losing their charge capacity over time.

Researchers at the Shenyang National Laboratory for Materials Science, in China, have been investigating how to improve the kind of rechargeable batteries that are almost ubiquitous in today's portable devices.

Mobile phones, mp3 players, personal digital assistants (PDAs), and laptop computers usually use lithium-ion batteries to give them portability. However, Li-ion batteries suffer from degradation especially when they get too hot or too cold and eventually lose the capacity to be fully recharged. This means a loss of talk time for mobile phone users and often no chance to use a laptop for the whole of a long haul flight.

The problem of the slow degradation of Li-ion batteries is usually due to the formation of a solid electrolyte interphase film that increase the batteries internal resistance and prevents a full recharge. Researchers have suggested using silicon in the composition of the negative electrode material in Li-ion batteries to improve charge capacity. However, this

material leads to even faster capacity loss as it repeatedly alloys and then de-alloys during charge-discharge cycles.

Shengyang's Hui-Ming Cheng and colleagues have turned to carbon nanotubes (CNTs) to help them use silicon (Si) as the battery anode but avoid the problem of large volume change during alloying and de-alloying. Carbon nanotubes resemble rolled-up sheets of hexagonal chicken wire with a carbon atom at the crossover points of the wires and the wires themselves being the bonds between carbon atoms, and they can be up to a millimeter long but mere nanometers in diameter.

The researchers grew carbon nanotubes on the surface of tiny particles of silicon using a technique known as chemical vapor deposition in which a carbon-containing vapor decomposes and then condenses on the surface of the silicon particles forming the nanoscopic tubes. They then coated these particles with carbon released from sugar at a high temperature in a vacuum. A separate batch of silicon particles produced using sugar but without the CNTs was also prepared.

With the new Si-CNT anode material to hand, the team then investigated how well it functioned in a prototype Li-ion battery and compared the results with the material formed from sugar-coated silicon particles.

They found that after twenty cycles of the semi-cell experiments, the sugar-coated Si-CNT composite material achieved a discharge capacity of 727 milliamp hours per gram. In contrast the charge capacity of the simple sugar-coated particles had dropped to just 363 mAh per gram.

Source: Inderscience Publishers

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