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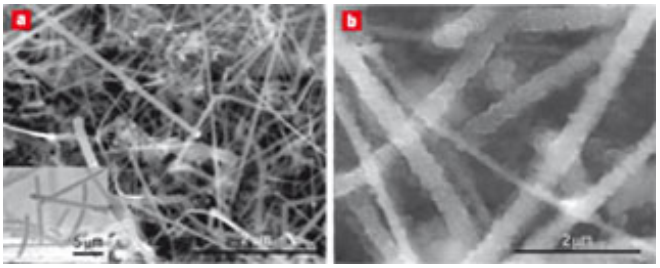
Silicon nanowire boost for rechargeable batteries

17 December 2007

Scientists in the US have devised an easy way of using silicon nanowires to increase the capacity of lithium batteries - like those in laptops - by up to five times.

A lithium battery delivers charge by transferring lithium ions from the anode - usually made from graphite - to the cathode (a metal oxide). The team from Stanford University, US, replaced the graphite anode with one made from silicon nanowires grown directly onto the battery's stainless steel charge collector with a gold catalyst. The new battery has a charge capacity of 4277mA hours per gram - over ten times higher than that of graphite and close to the theoretical maximum. The nanowire battery also maintained its capacity over 10 cycles of charging and discharging - better than any other result to date.



Scanning electron microscope image of silicon nanowires before (a) and after (b) electrochemical cycling

Silicon is an obvious choice for making anodes because it has can store more charge than other materials. But it expands by up to 400 per cent when charged with lithium ions and anodes made from thin films or particles of the material have tended to disintegrate under the strain.

The US team found that silicon nanowires do not suffer from similar problems because they don't stretch much when charged - they just get fatter.

Yi Cui, assistant professor at the Department of Materials Science and Engineering, Stanford and co-author of the paper, told *Chemistry World* the technique would be industrially scalable 'at a modest cost'. 'Our nanowire electrode is fabricated during the nanowire synthesis. By using the growth substrate as the current collector, our fabrication is faster and easier [than conventional methods],' he said.

Some researchers contacted by *Chemistry World* questioned whether the technique would be useful for commercial batteries. 'The most appealing result is obviously the high cycling capacity that these materials are able to deliver,' said one leading expert on lithium battery anodes, who asked not to be named. 'However, the test is limited to only 10 cycles and this is far too few to determine the industrial impact of the electrode. Also, the rate of the cycling test is very low and thus the power capability, another important practical requisite, has not been ascertained.'

Jonathan Edwards

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References

C K Chan et al, *Nature Nanotech*, 2007, DOI: 10.1038/nnano.2007.441

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