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Sharpest cut from nanotube sword

Carbon nanotech may have given swords of Damascus their edge.

Katharine Sanderson

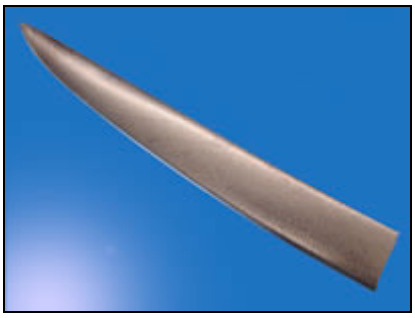
Think carbon nanotubes are new-fangled? Think again. The Crusaders felt the might of the tube when they fought against the Muslims and their distinctive, patterned Damascus blades.

Sabres from Damascus, now in Syria, date back as far as 900 AD. Strong and sharp, they are made from a type of steel called wootz.

Their blades bear a banded pattern thought to have been created as the sword was annealed and forged. But the secret of the swords' manufacture was lost in the eighteenth century.

Materials researcher Peter Paufler and his colleagues at Dresden University, Germany, have taken electron-microscope pictures of the swords and found that wootz has a microstructure of nano-metre-sized tubes, just like carbon nanotubes used in modern technologies for their lightweight strength.

The tubes were only revealed after a piece of sword was dissolved in hydrochloric acid to remove another microstructure in the swords: nanowires of the mineral cementite.



Damascus sabres may get their pattern and strength from nanotubes in the steel.

Alexander Dietsch

Wootz's ingredients include iron ores from India that contain transition-metal impurities. It was thought that these impurities helped cementite wires to form, but it wasn't clear how. Paufler thinks carbon nanotubes could be the missing piece of the puzzle.

At high temperatures, the impurities in the Indian ores could have catalysed the growth of nanotubes from carbon in the burning wood and leaves used to make the wootz, Paufler suggests. These tubes could then have filled with cementite to produce the wires in the patterned blades, he says.

But his suggestion isn't necessarily rock solid. Steel expert John Verhoeven, of Iowa State University in Ames, suggests Paufler is seeing something else. Cementite can itself exist as rods, he notes, so there might not be any carbon nanotubes in the rod-like structure.

Another potential problem is that TEM equipment sometimes contains nanotubes, says physicist Alex Zettl of the University of California, Berkeley. Paufler admits it is difficult to exclude the problem but says that, having studied the swords with a range of different equipment, he is convinced that the tubes he sees are from the swords.

If Paufler is right, nanotube researchers do not mind being pre-empted by Indian steel-makers. "The important fact is that nanotubes were serving some very useful purpose even before they were discovered," says chemist Andrei Khlobystov of the University of Nottingham, UK. "This should inspire us to look for new practical applications of these remarkable nanostructures."

The next step, says Paufler, will be to take the latest carbon nanotube knowledge and work with bladesmiths to try and recreate the lost process.

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References

1. ReiboldM., *et al*. *Nature*, **444**. 286 (2006). | Article |

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