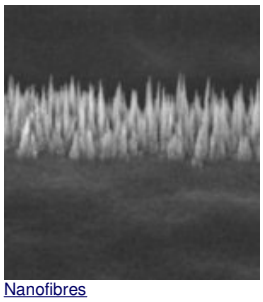
Scientists grow carbon nanofibres straight onto plastic

4 December 2003

Researchers from the University of Cambridge, UK, have deposited carbon nanofibres directly onto plastic substrates using plasma-enhanced chemical vapour deposition. The arrays of fibres could have applications as field emitters in displays.



Nanofibres

"We were able to grow carbon nanofibres directly onto low-temperature plastic substrates for the first time," Stephan Hofmann told *nanotechweb.org*. "Using well-established lithography techniques, we readily demonstrated a nanoscale definition on the new, flexible platform."

Hofmann and colleagues deposited nanofibres onto a commercially available polyimide film coated with a 70 nm thick layer of chromium and a 6 nm layer of nickel catalyst. Patterning the nickel by disposable shadow masks or by e-beam lithography produced feature sizes of 10 microns or 100 nm, respectively. The scientists grew the nanofibres onto the catalyst at 200 °C with a dc glow discharge chemical vapour deposition system, using acetylene as the carbon precursor and ammonia as an etchant. In this way, they deposited arrays of nanofibres in dots and lines.

"Our main focus was on the influence of the plasma atmosphere and the catalyst/support material used," said Hofmann. "We realised that the plasma not only aligns the as-grown structures perpendicular to the substrate - due to the imminent electric field - but also enables low-temperature growth."

The process grew carbon nanofibres that were 20-50 nm in diameter: field emission measurements of the nanofibre arrays showed a turn-on field of 3.2 V/micron and a threshold field for electron emission of just 4.2 V/micron.

"We think that the merger of nanoscale building blocks with polymer-based substrate materials could impact a broad spectrum of applications, ranging from wearable displays to fuel cells," said Hofmann. "Against common perception, many potential applications do not actually require the carbon structures to be highly crystalline. For templating or use as electrode materials, for instance, less crystalline carbon nanofibres work at least equally well."

Now the scientists, who reported their work in *Applied Physics Letters*, plan to investigate different heating techniques and catalyst precursors for the growth process.

About the author

Liz Kalaugher is editor of *nanotechweb.org*.

Author

Liz Kalaugher

Tel +44 (0)117 929 7481 | Fax +44 (0)117 930 1178 | E-mail info@nanotechweb.org