High-mobility semiconducting carbon nanotubes

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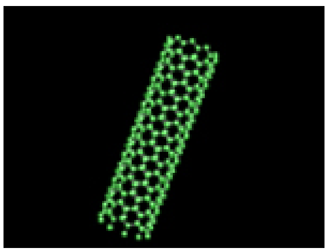

T Durkop, B M Kim and M S Fuhrer reviewed experiments to determine the resistivity and charge-carrier mobility in semiconducting carbon nanotubes in Journal of Physics: Condens. Matter (vol. 16, 2004, R553-R580)
Electron transport experiments on long chemical-vapour-deposition-grown semiconducting carbon nanotubes are interpreted in terms of diffusive transport in a field-effect transistor. This allows for extraction of the field-effect and saturation mobilities for hole carriers, as well as an estimate of the intrinsic hole mobility of the nanotubes. The intrinsic mobility can **exceed** 100 000 $cm^2 V^{-1} s^{-1}$ at room temperature, which is **greater than any other known semiconductor**.

Scanned-probe experiments show a low degree of disorder in chemical-vapour-deposition-grown semiconducting carbon nanotubes compared with laser-ablation produced nanotubes, and show conductivity and meanfree-path consistent with the high mobility values seen in transport experiments.

The results indicate that semiconducting nanotubes should be an excellent material for a number of semiconductor applications, especially in high-speed transistors where mobility is crucial.

The application of high-mobility semiconducting nanotubes to charge detection and
memory is also reviewed; it is shown that single electronic charges may be
detected with a semiconducting nanotube field-effect transistor at operating
temperatures up to 200 K.

The results suggest that semiconducting nanotubes may find applications as exquisite sensors of e.g. chemical or biochemical species, in which a chemical signal is translated into charge. Single molecule detection appears feasible with such a device.

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