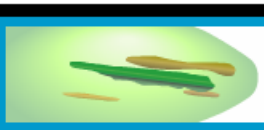

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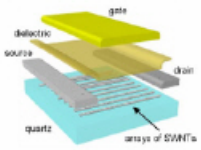
TECHNOLOGY UPDATE

Jan 28, 2008

Nano-radios move on

The first transistor radio made entirely of carbon nanotube active devices has been developed by researchers in the US. John Rogers of the University of Illinois and colleagues say their method, which uses aligned arrays of nanotubes in the form of "sheets" for the semiconductor, represents an advance over other techniques to implement nanotubes in electronics, including recent nano-radio demonstrations. This is because it is reproducible and scalable, thus allowing the routine fabrication of large numbers of radios and circuits - all using standard electronic processing techniques. The researchers have already used their nanoradio to listen to the traffic report from a local radio station.

"We developed the materials, device and circuits to form all the key building blocks for a nanotube-based radio-frequency analogue electronics technology," Rogers told *nanotechweb.org*. "We accomplished this using approaches that are fully compatible with existing electronics fabrication and in a way that is also reproducible and scalable."



RF transistor

The main challenge in the work was to create horizontally aligned arrays of individual nanotubes in a single-step growth process across the entire surface of a wafer substrate, explains Rogers. The researchers then had to incorporate the nanotubes into RF transistors and circuits. The nanotubes were almost perfectly linear and almost perfectly aligned and parallel to each other, which allowed the team to make a large number of transistors.

"Each device in such an approach incorporates thousands of tubes, such that the statistical averaging effects lead to good device-to-device uniformity in electrical properties," said Rogers. This holds true even for nanotubes that are themselves electronically heterogeneous - a first in nanotube-based radio technology.

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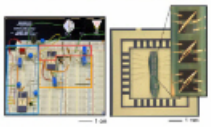

The radio

Since the tubes in each transistor device operate in parallel and independently, the devices can produce large current outputs. This means that they can have high levels of gain and amplification in both the RF and audio frequency ranges. "The latter even allows the user to listen through headphones connected to a nanotube transistor," said Rogers.

More importantly, many devices can be produced at once and integrated into circuits. Such features were absent from nanoradios and other electronic devices that incorporated only single nanotubes.

Unique array geometry

"Ours is a technology that enables all of the components (resonant antennas, RF amplifiers and mixers, and audio amplifiers) to be formed with nanotube devices," added Rogers. "These capabilities derive from their unique array geometry."

The researchers showed that their radio worked by tuning it to pick up a traffic report in Baltimore, MD. They are now building medium-scale circuits containing up to 100 transistors and are also implementing advanced designs to improve the RF response. "Finally, we are working to advance certain aspects of the devices by using new materials for contacts to the tubes, and increasing the power efficiency of the systems."

The work was reported in *PNAS*.

About the author

Belle Dumé is contributing editor at *nanotechweb.org*