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'Nanonet' technology may soon make for flexible electronics

From ANI

London, July 24: A team of researchers from Purdue University and the University of Illinois at Urbana-Champaign claims to have overcome a major obstacle in producing transistors from networks of carbon nanotubes, a technology that could make it possible to print circuits on plastic sheets for applications including flexible displays, and an electronic skin to cover an entire aircraft to monitor crack formation.

The researchers say their work may help significant improve the so-called "nanonet" technology, which involves circuits made of numerous carbon nanotubes randomly overlapping in a fishnet-like structure.

They point out that the network is generally contaminated with metallic nanotubes, which cause short circuits.

According to them, their discovery solves this problem by cutting the nanonet into strips, preventing short circuits by breaking the path of metallic nanotubes.

"This is a fundamental advance in how nanotube circuits are made," Nature magazine quoted Ashraf Alam, a professor of electrical and computer engineering at Purdue University, as saying.

While experts at the University of Illinois at Urbana-Champaign led experimental laboratory research to build the circuits, Purdue scientists led research to develop and use simulations and mathematical models needed to design the circuits and to interpret and analyse data.

"These findings represent the culmination of four years of collaborative efforts between the Illinois and Purdue groups. The work established the fundamental scientific knowledge that led to this particular breakthrough and the ability to make circuits," said University of Illinois researcher John A. Rogers, Founder Professor of Materials Science and Engineering and a professor of chemistry.

The researchers have revealed that the nanonets are made of tiny semiconducting cylinders called single walled carbon nanotubes.

They say that metallic nanotubes form unavoidably during the process of making carbon nanotubes, and then link together in meandering threads that eventually stretch across the width of the transistor, causing a short circuit.

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"Other researchers have proposed eliminating the metallic nanotubes. Instead, we found a very nice way of essentially removing the effect of these metallic nanotubes without actually eliminating them," Rogers said.

Alam says that the research team has developed a flexible circuit containing more than 100 transistors, the largest nanonet ever produced and the first demonstration of a working nanonet circuit.

"Now there is no fundamental reason why we couldn't develop nanonet technologies. If you can make a flexible circuit with 100 transistors, you can make circuits with 10,000 or more transistors," he said.

He believes that this discovery may enable scientists to use carbon nanotube transistors to create high-performance, shock-resistant, lightweight and flexible integrated circuits at low cost.

One of the major advantages of the nanonet technology, according to Alam, is that it can be produced at low temperatures.

He says that this will enable the transistors to be placed on flexible plastic sheets that would melt under the high temperatures required to manufacture silicon-based transistors.

Alam believes that such a technology may give rise to an electronic skin that covers an aircraft, and automatically monitors the formation of cracks to alert technicians and thereby prevent catastrophic failures.

He says that the technology may also make it possible to integrate flexible displays into automotive windshields to provide information for drivers, to make "electronic paper" that displays text and images, to print solar cells on plastic sheets, and to make TV screens capable of being rolled up for transport and storage.

"For these types of applications, manufacturers might literally print, or stamp, circuits onto plastic sheets, like the roll-to-roll printing used to print newspapers," Alam said.

"The theory and simulation work done at Purdue shows there is always a way to break the metallic path and still keep the semi conducting carbon-nanotube path intact. The teams at Illinois and Purdue continuously provide insights about why things work the way they do and how to make them work better through combined modelling and experimental efforts," he said.

Future research may include work focusing on learning the reliability of the carbon nanotube circuits.

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