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Carbon nanotubes may replace metals in electronic applications

Washington, March 21: Scientists at the University at Buffalo Single Walled Carbon Nanotubes (SWCNTs), which are thousands of times stronger than metals, may one day replace metals in millions of electronic applications.

Professor Cemal Basaran, the director of the Electronics Packaging Lab in UB's School of Engineering and Applied Sciences, says that the four years of quantum mechanics calculations performed by him and his doctoral student Tarek Ragab have proved that higher current density in carbon nanotubes does not lead to electromigration and thermomigration.

It also produces just one percent of the heat produced by traditional metals like copper, he adds.

Telling about the yet another tantalizing property of CNTs that his research has revealed, Basarn says: 'It has been assumed that for carbon nanotubes, the electrical heating process would be governed by Joules law, where resistance in a circuit converts electric energy into heat. We are the first to show mathematically, from a quantum mechanics point of view, that carbon nanotubes do not follow Joules law.'

Basaran says that this essential difference between metals and carbon nanotubes lies in the way they conduct electricity.

'Even though carbon nanotubes are conductive, they do not have metallic bonds. As a result, they do not conduct electricity the way that traditional metals do,' he said.

The researcher says that conduction in conventional metals causes a scattering of electrons within the lattice of the material so that, when electrons move during conduction, they bump into atoms. This creates friction and generates heat, the same way a household iron works.

'On the other hand, in carbon nanotubes, electric conduction happens in a very different, one-dimensional 'ballistic' way. The electrons are fired straight through the material, so that the electrons have very little interference with the atoms,' he said.

He drew an analogy using the difference between a conventional railroad train and a magnetically levitated train.

'In the conventional train, you have friction between the wheels and the track. Through the generation of heat, that friction causes a loss of energy. But with a magnetically levitated train, the wheels and track are not in direct contact. Without that friction, they can travel much faster,' said Basaran.

According to him, the minimal amount of friction gives carbon nanotubes a

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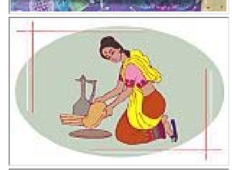

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