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Novel nanotube device for quantum transport and mechanics

A team of researchers develops a reliable process to fabricate high-quality carbon nanotube-based devices for quantum transport and mechanics.

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The storage, processing and transmitting of quantum information is the basis of quantum technology. Therefore, achieving quantum states that are isolated from the environment is key to the development of the field. Although remarkable progress has been made, in recent years, in the manufacture of quantum information processing devices, the presence of imperfections during the fabrication process can limit their quality.

One of the platforms for developing such devices are carbon nanotubes, quantum objects made of one concentric cylinder of graphene that can be synthesized and measured. They are widely used to study several quantum phenomena, as they have exceptional mechanical, electrical and optical properties that might be used for processing quantum information.

Now, a team of ICFO researchers at the Quantum NanoElectronics and NanoMechanics group **Roger Tormo-Queralt**, **Christoffer Moller**, **Stefan Forstner**, **Gernot Gruber**, **Chandan Samanta**, **Marta Cagetti**, **Jennifer Sanchez-Naranjo** and **Nuria Urgell-Olle**, led by **Prof. Adrian Bachtold** in collaboration with Suzanne Miller and David Czaplewski from the Center for Nanoscale materials, has developed a method to fabricate carbon nanotube devices with a large number of gate electrodes, demonstrating the high quality through quantum transport measurements. The study has been published in Nano Letters.

High-quality quantum devices

Researchers started with a prototype device which consisted of a carbon nanotube suspended over a gate made of platinum wires connecting a source and a drain electrode. Then, they moved on to miniaturize the gate electrodes, placing five 40 nm wide nanowires on top of silicon oxide ridges and separated by the same distance. This layout offered two main advantages. On one hand, the devices could stand the high temperatures of the chemical vapour deposition, up to 1000ºC, without major issues. Moreover, the final desig offered excellent quantum transport characteristics.

? This method could help build a new generation of high-quality quantum devices in ultracle n environments, which will allow the development of nanotubes without surfa

e contamination, potentially useful in applications related to the development
f double-quantum dots, spin qubits, and mechanical qubit

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