A cautionary note in the use of carbon nanotubes as interconnects

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(PhysOrg.com) -- Researchers at the University of Surrey's Advanced Technology Institute (UK) have used scanning tunnelling microscopy to confirm remarkable changes in the fundamental electronic behaviour when double-walled carbon nanotubes are subject to radial deformations and torsional strain.

The work reported in *Nano Letters* reveals that squashing and twisting a double-walled nanotube opens an electronic band gap in an otherwise metallic system, which has major ramifications on the use of carbon nanotubes for electronic and NEMS applications.

Dr. Cristina Giusca, the lead author of the paper said: "Fundamentally, the importance of the intershell interaction in collapsed double-walled carbon nanotubes points to the potential of a reversible metal-semiconductor junction, which can have device applications, as well as sending a cautionary note in the design of semiconductor components based on carbon nanotubes".

Since deformations can occur in response to the growth, processing or characterization conditions of carbon nanotubes, the work is of relevance in matters concerning the characterisation of these structures, as the majority of electronic transport measurements are performed using various metals to contact the nanotubes, and the measured values could in this case be affected by hidden contributions.

Professor Ravi Silva, who leads the Advanced Technology Institute,

indicated that "These findings are of crucial importance for the future integration of carbon nanotubes with conventional existing electronic technologies, where, for example, fabrication methods can induce deformations by placing control electrodes on top of nanotubes or by embedding the nanotubes into other structures".

Chief among the use of these structures would be carbon nanotubes as interconnects for the billion dollar semiconductor industry which, according to the ITRS roadmap, has yet to have a solution in place for 2012 integrated circuits. Therefore, the deformation and mechanical integrity study on a nano-scale of these essential components would be of paramount importance.

Additionally, the work should pose an excellent challenge to experimentalists to create ingenious ways which allow deforming carbon nanotubes in a controllable manner to easily provide the required metallic or semiconducting features. As high conformational deformations, similar to the ones presented in the paper, have been shown by simulations to significantly enhance locally the chemical reactivity of carbon nanotubes, controlled deformations could also find prospective applications for potential sensing devices.

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