

# **E**lectronic transport in multiwalled carbon nanotubes

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We have measured the low temperature transport properties of single multiwalled carbon nanotubes (MWNT) of diameters ( $D$ ) in the range 2-17 nm (Figure 1). Almost all previous work on MWNT's has been on tubes with diameters above 10 nm. In nearly all samples in this work, with  $D < 10$  nm, the gate dependent conductance exhibits a gap whose size increases with the inverse tube diameter and increasing electrode separation. This so called transport gap is attributed, based on the experimental findings, on a combination of localization effects and narrow diameter induced gaps in the electronic band structure.

These results have significant similarities to the current research on graphene nanoribbons (GNR). As graphene does not intrinsically possess a bandgap, GNR's are fabricated, where a gap is created via quantum confinement due to the narrow width of the channel/nanoribbon. The size of the gap is then roughly in a similar inverse relation with the width of the constriction as in the case of the diameter dependence of the MWNT's in our work.

The transport gap has not generally been observed in the previous works on MWNT's because of the large diameters of the tubes in these. Our work, of which some early results were published previously [1], complements and bridges previous works on both single walled nanotubes and MWNT's, and also to the field of GNR's.

## References

- [1] M. Ahlskog, O. Herranen, A. Johansson, J. Leppäniemi, and D. Mtsuko, Phys. Rev. B, 79 (2009) 155408.

## Figures



Figure 1: An AFM image of a multiwalled carbon nanotube connected to four microelectrodes.