# Quantum Transport in Strained Single-Wall Carbon Nanotubes

**Linxiang Huang**
A. C. McRae, G. Wei and A. R. Champagne
*Concordia University, Department of Physics, Montreal, Canada*
Contact@E-mail: linxiang.huang@mail.concordia.ca

Can we control quantum interferences and many-body interactions mechanically, i.e. by pulling on a nano-system? While many idealized theoretical proposals address this question [1], very few have been realized experimentally. To bridge this gap with single-wall carbon nanotubes (SWCNTs), we are developing simultaneously an experimental platform and an applied theoretical model. We nanofabricated high quality strain-tunable suspended SWCNT transistors. For the fabrication, we first located SWCNTs with a diameter smaller than 2 nm using scanning electron microscopy (SEM) and atomic force microscopy (AFM). We then patterned nanometer-scale bowtie-shaped Au break junctions (around 300 nm wide) on top of SWCNTs using electron beam lithography (EBL). Finally, we suspended our devices by removing the supporting $SiO_2$ beneath them, which after electromigration of the gold junctions [2], it will allow straining of ultra-short SWCNTs with our QTSE platform [3]. To guide the quantum transport measurements in our uniaxially strained SWCNT devices, we developed an applied theory considering dominant uniaxial strain effects and experimental realities. We predict a strong tunability of charge conductance via uniaxial strain in metallic SWCNTs and to a strain-tunable quantum transistor effect. Specifically, for armchair metallic tubes, we observe a valley filter behaviour where electrons are only allowed to flow through certain valleys of the band structure. We also predict the ability of uniaxial strain to modify the electron-hole transport asymmetry in semiconducting SWCNTs, which would permit to engineer two vastly different transport behaviour into a single device [2].

## REFERENCES

[1] G. G. Naumis et al., Reports on Progress in Physics, 9, (2017), 096501
[2] A. C. McRae et al., Nature communications, 1, (2017), 15491
[3] A. C. McRae et al., Physical Review Applied, 5, (2019), 054019.

## FIGURES

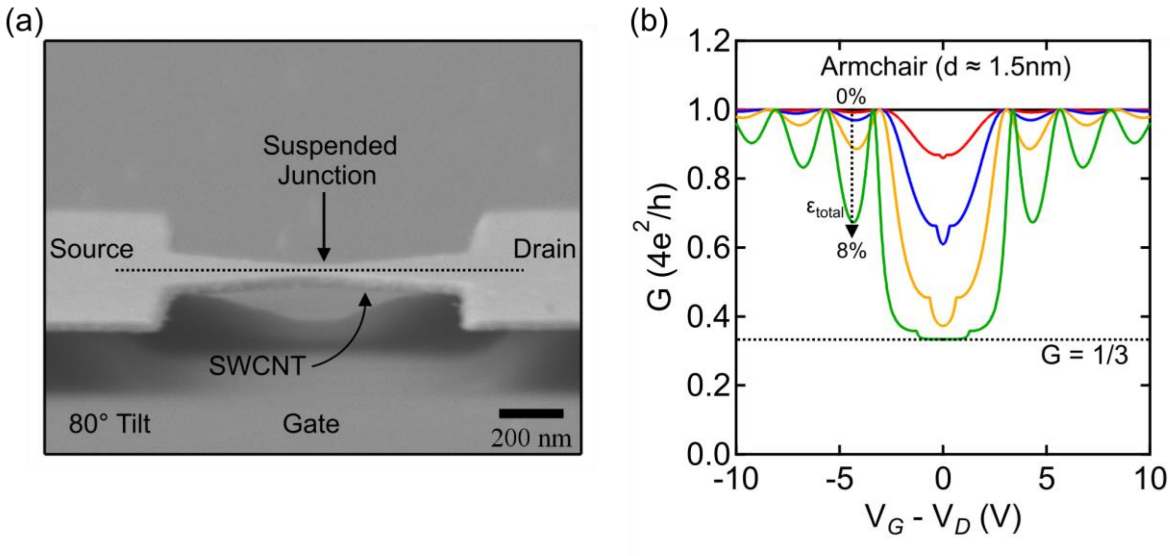


**Figure 1:** (a) Tilted SEM image of a suspended SWCNT junction. Gold contacts and the $SiO_2$/Si substrate act as source/drain and gate electrode, respectively, for strain transport measurements. (b) Conductance as a dependant of the gate voltage for uniaxial strain 0 %, 1 %, 2 %, 4 % and 8% (black, red, blue, gold, green) in an armchair SWCNT with the diameter around 1.5 nm. The conductance is suppressed and shows a perfect quantization of 1/3.