SAIP2013

Contribution ID: **198** Type: **Oral Presentation**

High temperature conductance fluctuations and Tomonaga - Luttinger liquid behaviour of aligned metallic SWCNT ropes.

Wednesday, 10 July 2013 09:20 (20 minutes)

Abstract content
   (Max 300 words)

One of the outstanding challenges in carbon nanotube research is to fully understand the effects of electron-electron interactions. To date most experiments can be understood by a combination of the non-interacting level spectrum embodied in the Coulomb blockade. In one-dimension (1D) electron-electron interactions are believed to more dramatic effects modeled by the Tomonoga-Luttinger liquid (TLL) theory. In this study TLL like behavior, within the 80 K – 300 K temperature range, was observed for ropes of metallic SWCNTs aligned by di-electrophoresis across a 1 micron gap between gold micro-electrodes. Current-Voltage characteristics of the devices showed conductivity steps that match theoretically predicted maxima in the DOS spectrum of nanotubes. Effects of confinement and electron-electron interaction distinctive to one dimension were identified in transport as a non universal power-law dependence of the differential conductance on temperature and source-drain voltage. Ballistic conductance at room temperature was confirmed from the high frequency transport of the SWCNT devices. The complex impedance showed some oscillatory behaviour in the frequency range 6 to 30 GHz, as has been predicted theoretically in the TLL model. By analyzing the low energy regime conductance (as function of voltage) characteristics at high temperatures we were able to observe the Coulomb blockade. In these devices the charging Coulomb energy of a single particle played a critical role in the overall device performance. This study can be used to understand the nature of plasmon dynamics which are the charge carriers in a TLL system and how the Coulomb interactions can be used in 1D to the design highly tunable systems for fabrication of single molecule devices.

Apply to be
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Level for award
 (Hons, MSc,
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MSc

Main supervisor (name and email)
and his / her institution

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Would you like to
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Session Classification: DCMPM1

Track Classification: Track A - Division for Condensed Matter Physics and Materials