Supporting Information (SI)

Physisorbed versus Chemisorbed Oxygen Effect on Thermoelectric Properties of Highly Organized Single Walled Carbon Nanotube Nanofilms

Milad Yarali[a], Ji Hao[b], Mohammad Khodadadi[a], Hatem Brahmi[a], Shuo Chen[c,d], Viktor G. Hadjiev[d], Yung Joon Jung[b], Anastassios Mavrokefalos[a,*]

[a]Department of Mechanical Engineering, University of Houston, Houston, TX, 77204, USA

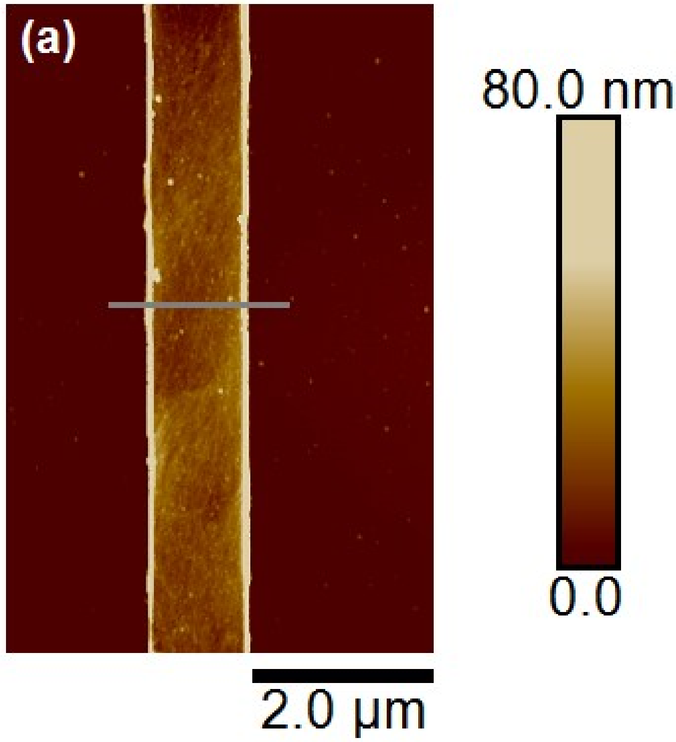
[b]Department of Mechanical and Industrial Engineering, Northeastern University, Boston, MA, 02115

[c]Department of Physics, University of Houston, Houston, TX, 77204, USA

[d]Texas Center for Superconductivity at the University of Houston (TcSUH), Houston, TX 77204, USA

To measure the thickness of the SWCNT film AFM topography image was acquired in the tapping mode using a Multimode AFM (Veeco Instruments). Deformability and lack of support make AFM scan of suspended SWCNT film quite challenging. Therefore, scanning was performed perpendicular to the strip axis located on the SiO_2 substrate before transferring the samples to the suspended devices. As shown in Fig. S1 thickness profile was taken by drawing a line across the film and the average film thickness and width were determined to be 19 nm and 1μm, respectively. Contracting meniscus at the ridge edges during drying process makes both edges of the film thickened.

*Corresponding author. Tel: 713 743-4531. E-mail: amavrokefalos@uh.edu (Anastassios Mavrokefalos)



(b)

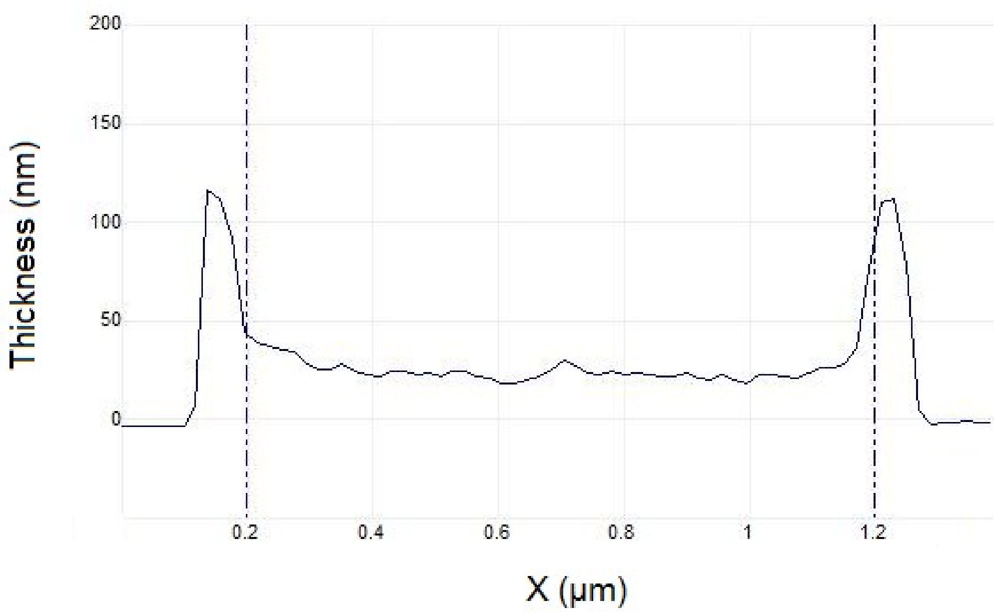


Fig. S1. (a) Surface topological scan using AFM. (b) Average thickness profile

The good alignment of the SWCNT networks along the direction of trench before the transfer process is shown in Fig. S2 that depicts the SEM image of SWCNT networks on the SiO_2 substrate.

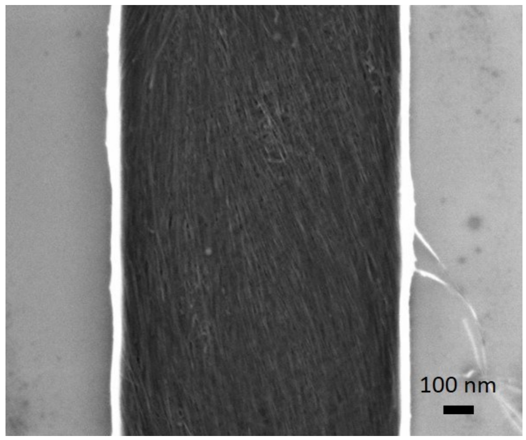


Fig. S2. SEM image of 1 μm SWCNT networks on the SiO_2 substrate.

We carried out Raman spectroscopy characterization of sample 1 under 514 nm laser excitation before and after thermoelectric characterization. It can be seen from Fig. S3 that the SWCNT network shows basically same Raman spectra before and after measurement. Comparison of two spectra confirms that (1) there is no change in the SWCNT diameter distribution after measurements, (2) the structural characteristics of the SWCNT network is not affected by the PMMA residues and (3) after exposing the SWCNT network to the ambient air it regains its p-type behavior as illustrated by the Seebeck measurements in Fig. S4.

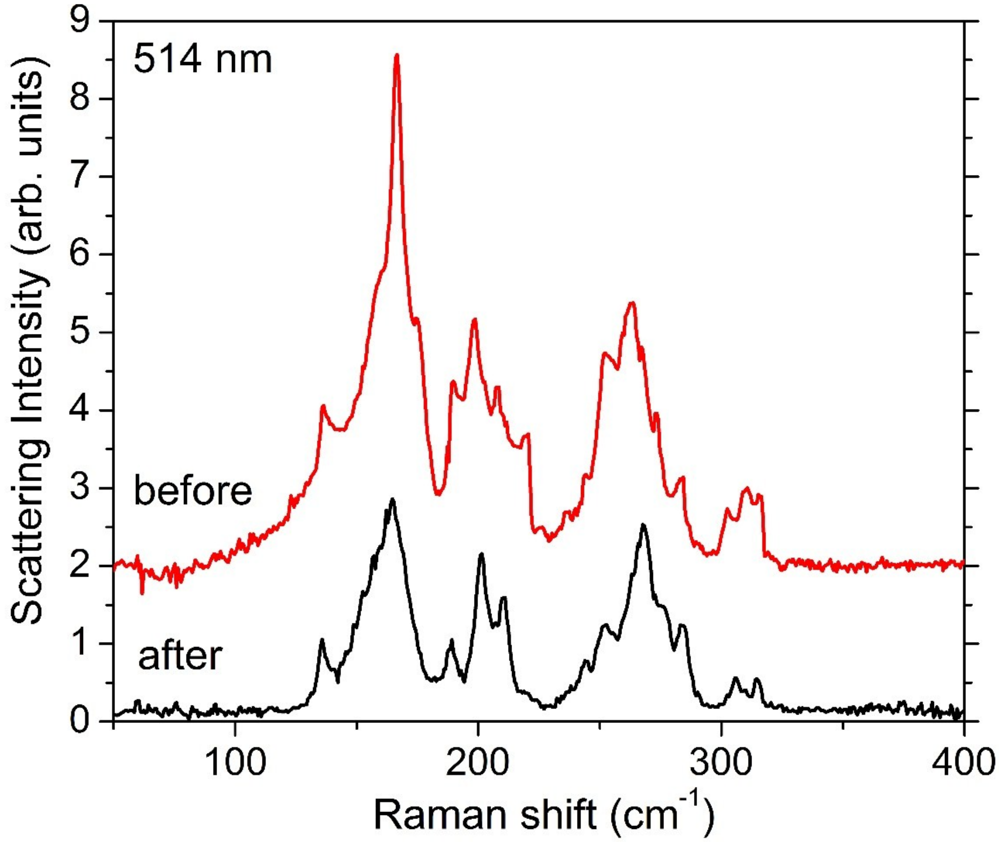


Fig. S3. Raman spectra of sample 1 recorded under 514 nm laser excitation before and after thermoelectric measurements.

Unfortunately the microdevice, on which the sample 1 was assembled, was damaged during TEM imaging. Thus, we prepared a new sample and preformed two heating/cooling cycles. Fig. S4 shows the temperature dependent Seebeck coefficient of the new sample. After the first heating/cooling cycle (following the same procedure as sample 1 described in the manuscript), the sample was exposed to ambient air for 1 hour. Then the second heating/cooling cycle was preformed under vacuum. As it is depicted in the Fig. S4 the SWCNT network regains its p-type behavior (positive *S*) after exposure to ambient air and again transition to n-type (negative *S*) by vacuum annealing. It hence indicates that the sign change of Seebeck coefficient is reproducible by exposing the SWCNT network to the ambient air.

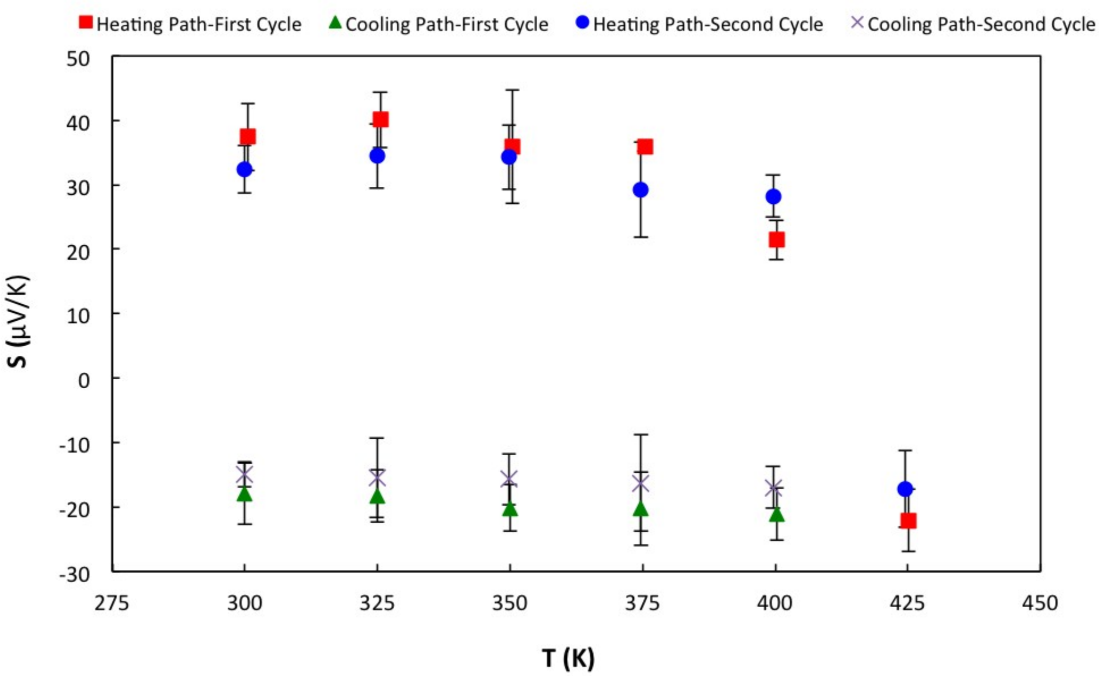


Fig. S4. Temperature dependent Seebeck coefficient of the new sample.