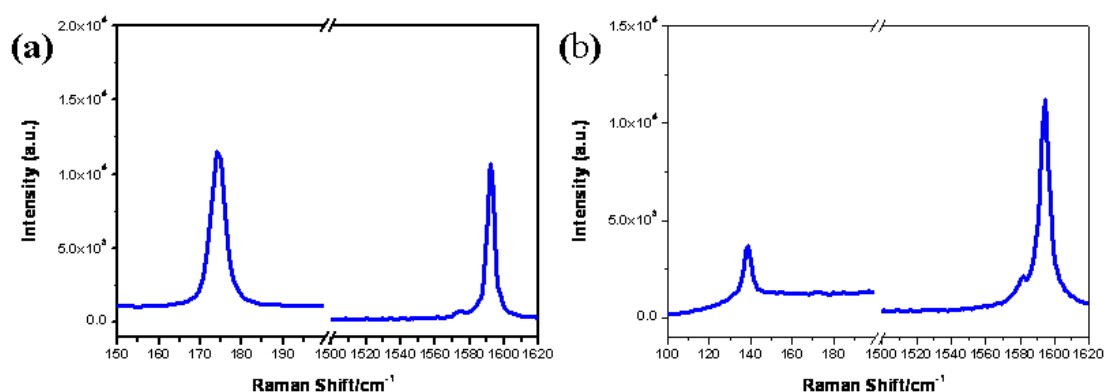


## Supplementary Information

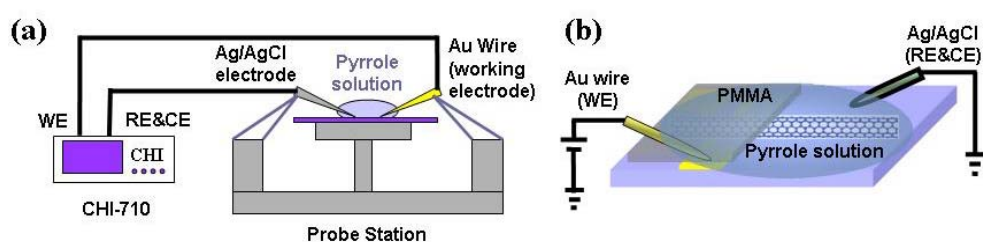
### Part 1: Experimental details:

Silicon wafers (P-type <111>, resistivity: 0.004-0.008  $\Omega$  cm, thickness:  $525 \pm 20$   $\mu$  m) with 300nm thermally grown SiO<sub>2</sub> layer were used as the substrates to fabricate the electrodes patterns and grow carbon nanotubes. Pt or Au electrodes were fabricated on silicon wafer by electron-beam lithography (EBL) and Ti/Pt or Ti/Au deposition, followed by a standard lift-off process. The ultralong SWNTs were grown by CVD method directly on the wafer with Ti/Pt electrodes. Briefly, ultralong SWNTs arrays were synthesized by catalytic CVD using ethanol as the carbon source. FeCl<sub>3</sub> solution (0.01M in ethanol) was applied to one edge of a SiO<sub>2</sub>/Si substrate by micro-contact printing and served as catalyst precursor. The ethanol vapor was introduced into the furnace by bubbling 200 sccm Ar through the ethanol at a growth temperature of 950 °C. Also, ultralong SWNTs were transferred onto the wafer with Ti/Au electrodes using the PMMA-mediated nanotransfer printing technique we developed recently. Briefly, a polymer film was formed on a SWNTs contained substrate by spin-coating. The film was then peeled off together with nanotubes and placed on a target substrate. Finally, the polymer film was removed by solvent washing and the SWNTs were left on the target substrate. The location of certain SWNT can be precisely controlled by alignment. The samples with transferred SWNTs on Ti/Au electrodes were annealed at 300 °C in air for 30 min to improve the contact and remove the contamination. *I-V* measurements were carried out on a probe station using Keithley 4200 Semiconductor Characterization System to determine whether the nanotube was semiconducting or metallic. Renishaw micro-Raman system (1 $\mu$ m spot-size, He-Ne laser) with 633 nm (1.96 eV) laser excitation was used to obtain the resonant Raman spectra of the as-grown ultralong SWNTs. The

PMMA control strip was spin-coated and EBL-patterned onto the nanotube-metal contact area with a typical strip width of 50  $\mu\text{m}$  from the electrode edge. Electrodeposition of polypyrrole was performed by dropping a drop of pyrrole solution (25mM pyrrole and 0.1M SDS in water) over the device, followed by applying a bias voltage on the nanotube (vs. Ag/AgCl) using CHI-710 electrochemical workstation. The samples were characterized by Hitachi 4800 scanning electron microscope (SEM) typically at 1kV and Nanoscope III SPM (Veeco) in Tapping-mode AFM.



**Fig. S1** Typical Raman spectra of (a) metallic SWNT and (b) semiconducting ultralong SWNT under 633nm laser excitation. The RBM and G-band confirmed that the as-grown tubes were SWNTs.



**Fig. S2** Experimental setup for electrodeposition of polypyrrole on SWNTs. (a) A CHI-710 electrochemical workstation was connected to probe station with coaxial cable. (b) A gold wire was used to contact with the microelectrode for applying a bias voltage on SWNT and an Ag/AgCl was used as the reference electrode and counter electrode.

**Part 2: statistics of polypyrrole thickness and the corresponding tube diameter with and without PMMA control strip:**

<b>NO.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Original diameter/nm</b>	<b>1.7</b>	<b>2.0</b>	<b>1.1</b>	<b>1.2</b>	<b>1.9</b>	<b>0.7</b>	<b>1.4</b>	<b>2.0</b>
<b>M/S (on/off current ratio)</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>S (10<sup>5</sup>)</b>	<b>S (10<sup>4</sup>)</b>	<b>S (10<sup>4</sup>)</b>	<b>S (10<sup>4</sup>)</b>
<b>Thickness/nm</b>	<b>151.3</b>	<b>195.0</b>	<b>226.9</b>	<b>227.8</b>	<b>139.1</b>	<b>100.3</b>	<b>147.6</b>	<b>183.0</b>

**Table S1** Statistics of polypyrrole thickness electrodeposited on SWNTs and the corresponding metallic/semiconducting tube diameter without PMMA control strip.

<b>NO.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Original diameter/nm</b>	<b>1.7</b>	<b>2.7</b>	<b>2.4</b>	<b>1.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.5</b>	<b>2.0</b>	<b>1.4</b>	<b>1.4</b>
<b>M/S (on/off current ratio)</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>S (10<sup>3</sup>)</b>	<b>S (10<sup>4</sup>)</b>	<b>S (10<sup>4</sup>)</b>	<b>S (10<sup>4</sup>)</b>	<b>S (10<sup>4</sup>)</b>
<b>Thickness/nm</b>	<b>182.3</b>	<b>183.3</b>	<b>119.6</b>	<b>121.2</b>	<b>102.6</b>	<b>17.8</b>	<b>18.5</b>	<b>0.4</b>	<b>27.6</b>	<b>28.6</b>

**Table S2** Statistics of polypyrrole thickness electrodeposited on SWNTs and the corresponding metallic/semiconducting tube diameter with PMMA control strip.