Supporting information

S0 More details for device fabrication

The substrate was cleaned in solution of H_2O : H_2O_2 : NH_3 = 5 : 1 : 1 at 80 °C for 1 minute. Then it was rinsed by DI water and blow dried by nitrogen gas. After baking at 120 °C for 10 minutes, the substrate was soaked in the CNT solutions for CNTs deposition. Uniform CNT network will be deposited onto the substrate by electrostatic attraction between CNTs and the substrate. The density of the network can be tuned by the soaking time, and longer soaking time results in higher density. For 24 hours' deposition, the area density of the CNT film is ~40 tubes/μm^2. Similar density was obtained for both glass and Si substrate with the same deposition time.

S1 More detailed information of Figure 1 in the main text.

S1.1 Location of the measured devices in the substrate

There are four same groups of devices are designed in the substrate as shown in Figure S1.1. The device geometries are the same in each column but vary with columns. One kind of metal was deposited for each group. About 20 devices or so were measured in one column of each group, which have the same device geometry, as marked by the green rectangles in Figure S1.1.

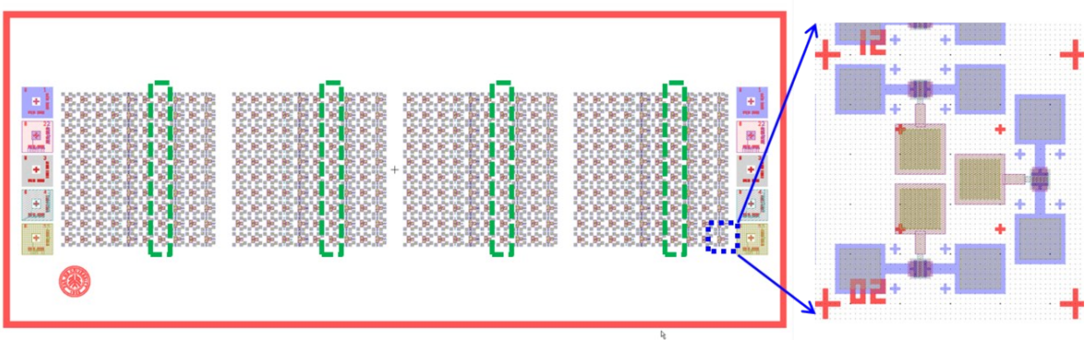
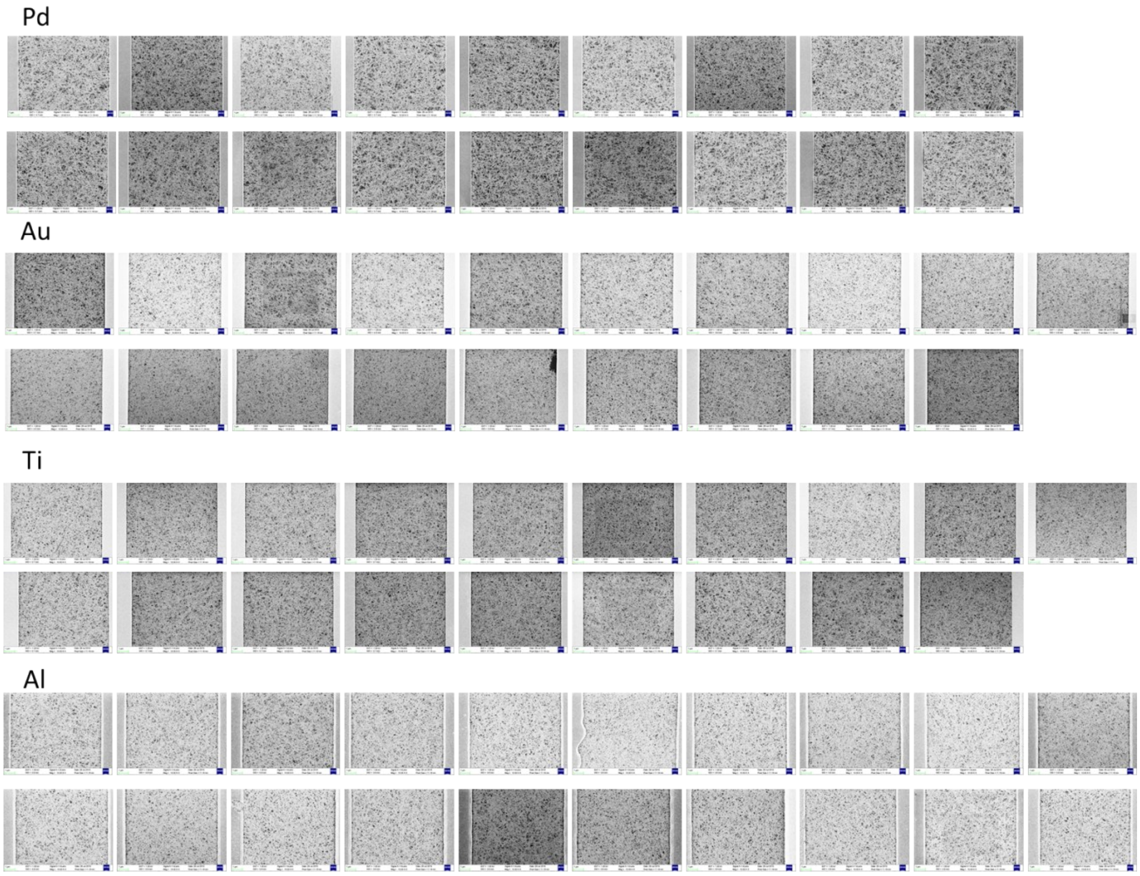


Figure S1.1

S1.2 SEM images of the four contact types of devices

The SEM images of all the devices measured corresponding to Fig.1 in the main text were shown below. No obvious difference was observed for all the images below. Form the images, and also considering the locations of these devices, we can conclude that the CNT film is pretty uniform everywhere in the substrate, and the difference in performance of the four type devices are due to the contacts.



Figrue S1.2

S1.3: Transfer curves at low and high bias

All of the measured transfer curves at low bias of the four types of devices were shown in Figure S1.3. Also, transfer curves at different bias of one typical device of each type were shown.

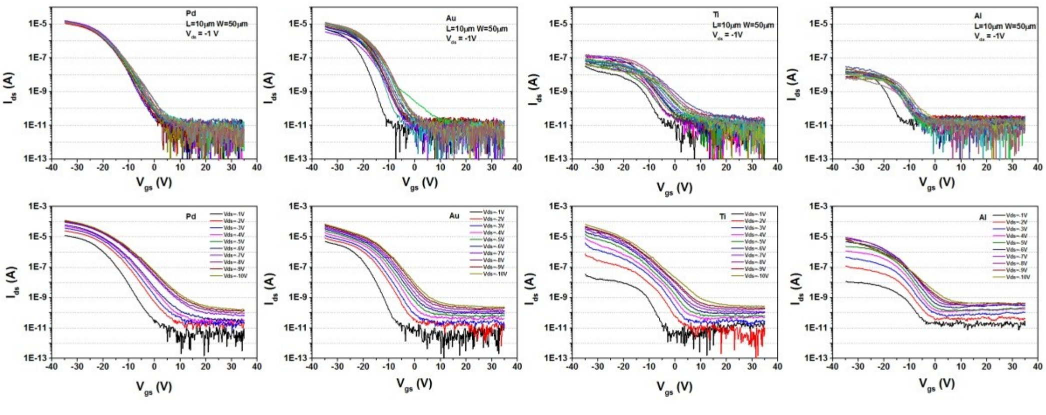


Figure S1.3

S1.4 Low bias out-put properties of the four types of devices.

As shown in Figure S1.4, the current changes linearly with bias for Pd contacted devices at on-state, almost linearly for Au contacted devices and nonlinearly for Ti and Al contacted devices. Therefore, Pd contacts are ohmic, Au contacts are nearly ohmic, and Ti and Al contacts are SB type.

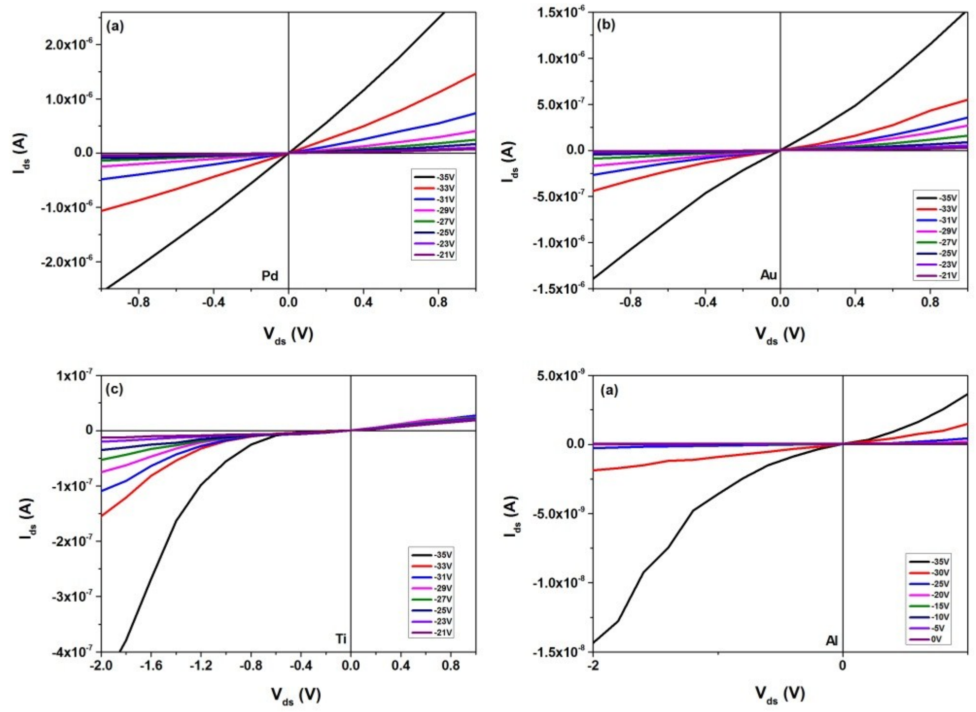


Figure S1.4

S1.5 Threshold voltage (V_{th}) and sub-threshold swing (SS) of the four types of devices which were extracted form Figure S1.3.

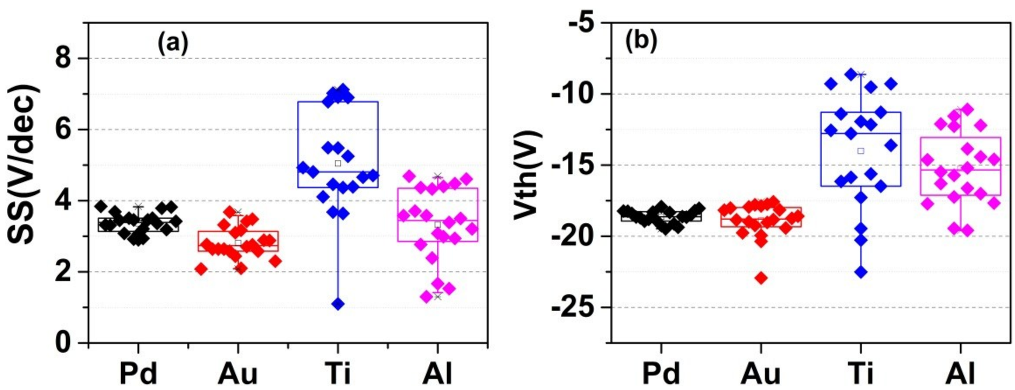


Figure S1.5

S2 Relative fluctuation of the on-state currents shown in Figure 1e in the main text.

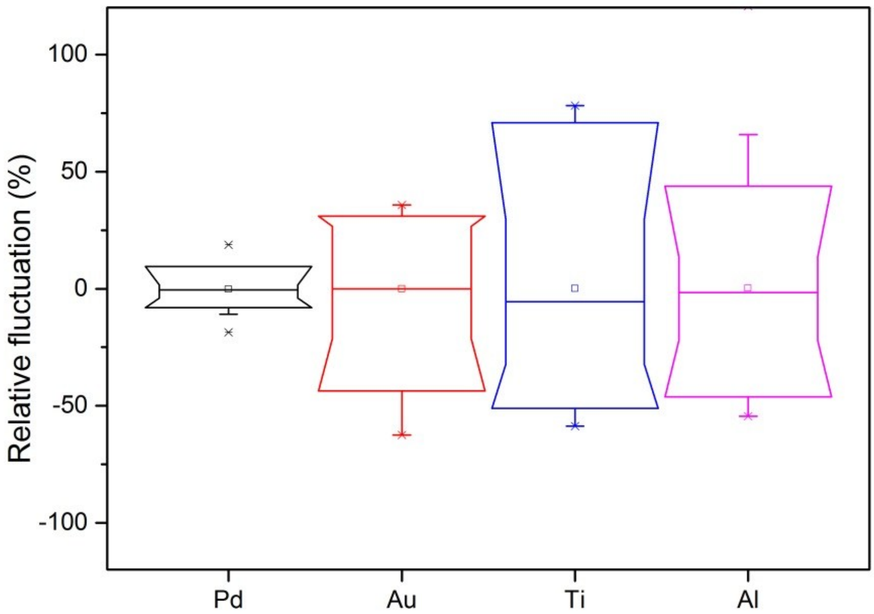


Figure S2

S3 Transfer curves of devices in Figure 4 in the main text

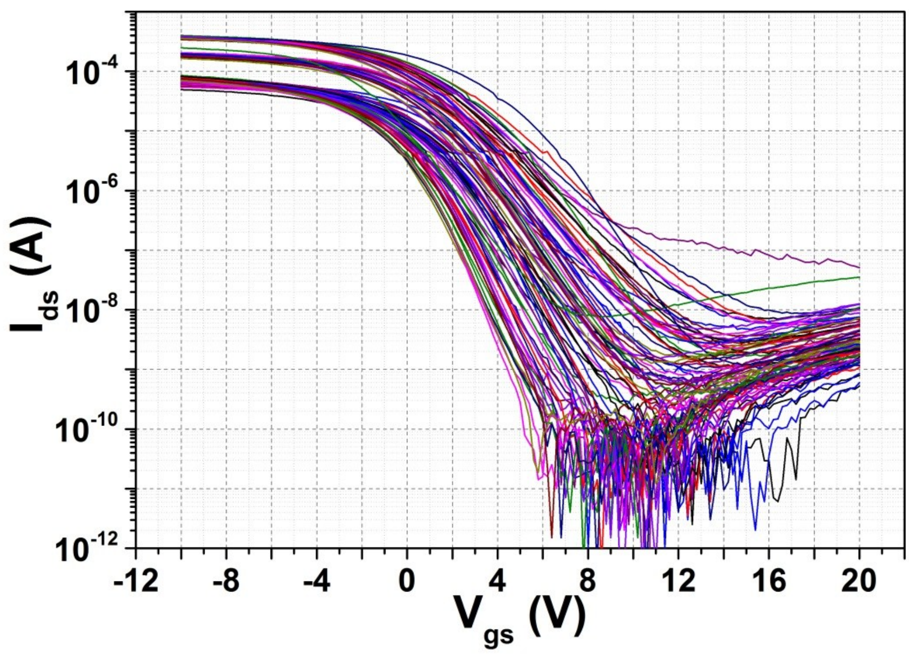


Figure S3

S4 Model of gate capacitance

Usually two models of the gate capacitance are used for CNT-TFTs. One is the conventional parallel plate model, the other is a so-called rigorous model[1] which the non-continuity of the CNT film was concerned. The extracted mobility value will be different of the two models, and the value by rigorous model is relatively higher. Actually, the data analysis and conclusion of this paper do not affected by which model was used. In the main text of the paper, parallel plate model was used. Here we provide the results of the rigorous capacitance model for those in Fig.4 of the main text. Figure S4(a) shows the mobility extracted by equation (1) in the main text, while Figure S4(b) shows the YFM results. Rigorous capacitance model were used in both figures. The scaling exponents, m_{μ}, are the same by the two capacitance models.

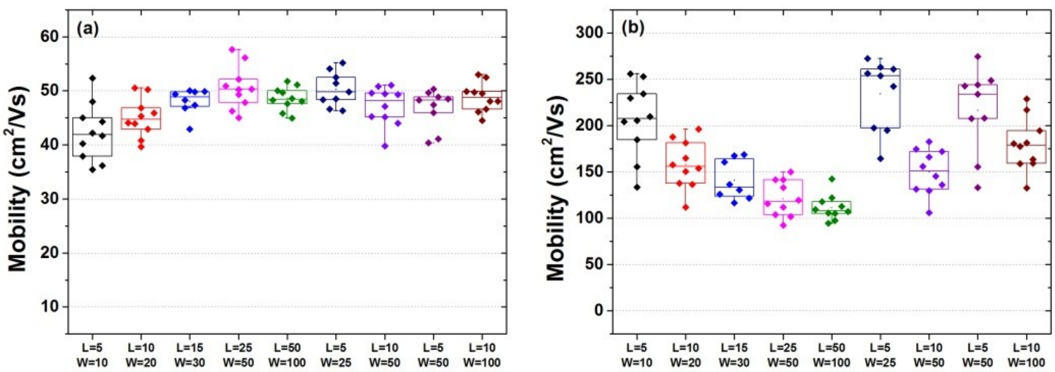


Figure S4

S5 More information of Figure 5 in the main text

S5.1 Calculation of the calibrated current

As discussed in the main text, the total voltage was shared by $2R_c$ and the channel. We subtract the $2R_c$ from the R_{tot} and calculate the calibrated current by the following equation:

$$I^{Cal.} = \frac{V}{\frac{V}{I} - 2R_C}$$

S5.2 Contact resistances of Figure 5d in the main text.

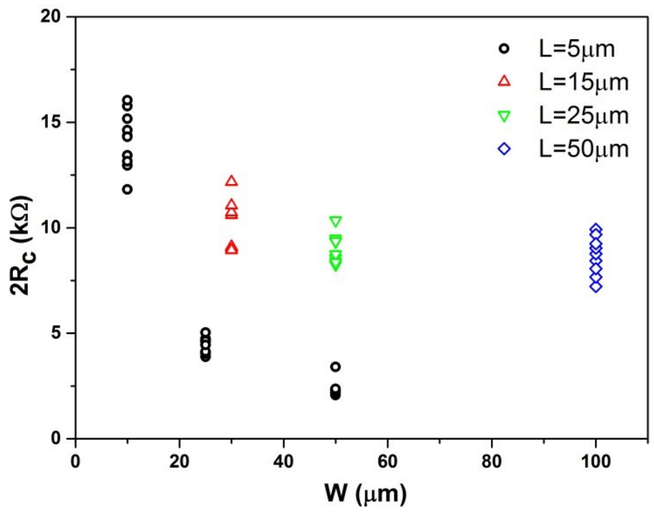


Figure S5

It can be seen that $2R_c$ decreases with W increase for the same L (black circle). However, $2R_c$ increases with L for the same W (compare the data of W=30μm).

Reference

1. Q. Cao, M. Xia, C. Kocabas, M. Shim, J. A. Rogers and S. V. Rotkin, *Appl Phys Lett*, 2007, **90**, 023516.