Supplementary Information

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I. Transfer of SWNTs grown on ST-cut quartz onto SiOx/Si wafers.

The transfer process has been adapted from Ref. S1[1] with some modifications. It consists of six steps.

1. Spin-cast a drop of 8% poly (methyl methacrylate) (495K molecular weight) (PMMA) solution in anisole on SWNTs/quartz at 4000 rpm for 30 sec. to form a PMMA layer.

2. Bake the substrate at 140ºC for 15 min.

3. Immerse the PMMA/SWNTs/quartz substrate in boiling KOH (1 mol/L) aqueous solution for 10 min. The PMMA/SWNTs film should be peeled off from the quartz at the end of this step.

4. Take the film from the KOH solution, wash the film with water, and then carefully put onto a TEM grid.

5. Bake the PMMA/SWNTs/grid at 140ºC for 2 min.

6. Bake the PMMA/SWNTs/grid at 400ºC for 1h in a flow of 100 sccm Ar and 100 sccm H_2 to obtain well-aligned SWNTs on the TEM grid.

Figure S1 shows a typical transfer result. No changes of the alignment of the SWNTs have been found after the transfer.

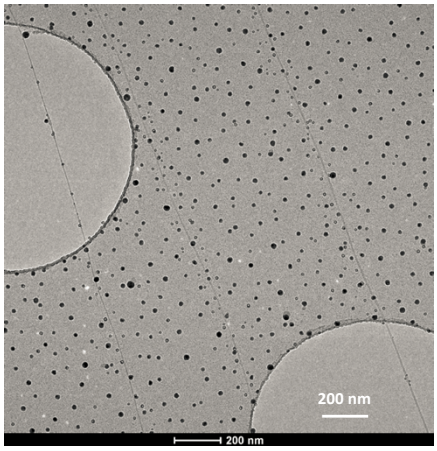


Figure S1. HRTEM image of the transferred SWNT array grown by Cu catalyst on quartz. The good alignment was maintained after transfer process, which had no solvent involved during the removal of PMMA polymer. The

black dots were formed by aggregation of residual PMMA.

II. Water concentration calculation

Combustion of H_2 follows the following equation

$2H_2 + O_2 \rightarrow 2H_2O$

With only small amount of H_2 introduced, the O_2 in air is considered as excess reactant, so the amount of H_2O product is determined by the amount of H_2.

So the concentration of H_2O vapor C_{H_2O} produced by the reaction in the CVD chamber is:

$$C_{H_2O} = m_{H_2O} / V_{total} \quad (1)$$

Where m_{H2O} is mass of the water, V_{total} is the volume of the quartz tube used for the annealing and the CVD growth, which is 600 ml;

$$m_{H_2O} = n_{H_2O} * M_{H_2O} \quad (2)$$

where n_{H2O} is the mole number of water, and M_{H2O} is molar mass of water, 18 g/mol, then we have

$$C_{H_2O} = n_{H_2O} * 18\ \boldsymbol{g/mol} / 600\ \boldsymbol{ml}$$

According to the chemical equation,

$$n_{H_2O} = n_{H_2} \quad (3)$$

and

$$n_{H_2} \approx V_{H_2} / R = v_{H_2} * t/R \quad (4)$$

Where V_{H2} is the volume of H_2 introduced into the system, t is the duration of H_2 introduction, and the flow rate of H_2 v_{H_2}, is fixed at 180 sccm. H_2 is treated as ideal gas here, so R= 22.4 L/mol.

Then we get

$$C_{H_2O} = v_{H_2} * t/R * M_{H_2O} / V_{total} = \boldsymbol{180\ ml/min} * t(\boldsymbol{min}) / 22.4\ \boldsymbol{L/mol} * 18\ \boldsymbol{g/mol} / 600\ \boldsymbol{ml} \quad (5)$$

$$C_{H_2O} = 4.0 * t(\boldsymbol{min})\quad \boldsymbol{g/L} \quad (6)$$

When H_2 is introduced for 20 seconds, the C_{H_2O} will be 1.3 g/ L, which is 1300g/ m^3, which is much higher than saturated concentration of water vapor in air at room temperature, 18.5 g/m^3.

We chose to introduce water by H_2 combustion because of the high water vapor concentration it produced at the moment of the reaction happening.

III. Statistic on the diameter distribution of both aligned and kinked SWNTs in Cu and CoMo catalyzed system.

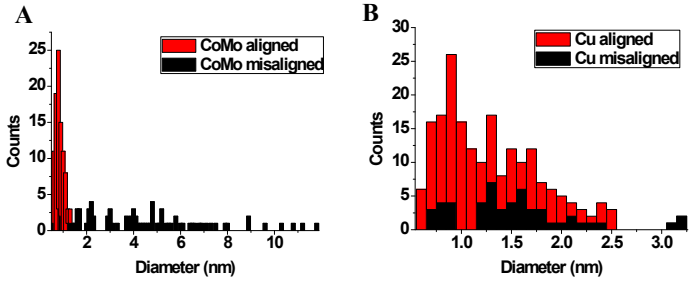


Figure S2. The diameter distribution of both aligned and misaligned (kinked) SWNTs in Cu (A) and CoMo (B) catalyzed system. The systems using the same catalyst were considered together regardless of the annealing condition. The diameter of the SWNTs were measured by AFM.

IV. Investigation of etching effect of water on quartz substrate under high temperature.

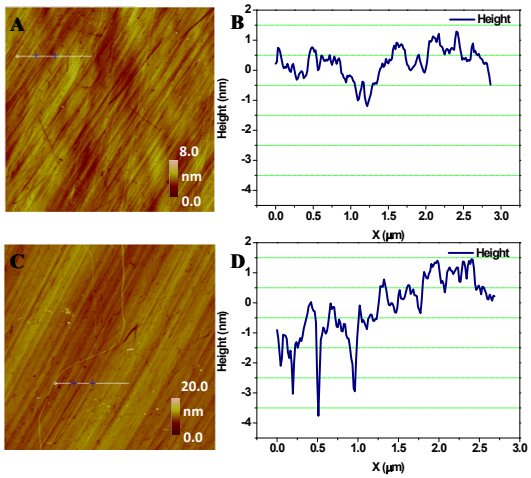


Figure S3. AFM images of SWNTs grown on quartz substrate by using Cu-w (A), Cu (C) as catalyst respectively; and corresponding section analysis results of the substrate morphology with(D) and without(B) water during catalyst annealing process. The AFM image sizes are 8 × 8 um. The section plot shows the height profile of selected area along the white line in AFM image. The section analysis line was drawn based on the scan direction of the AFM probes.

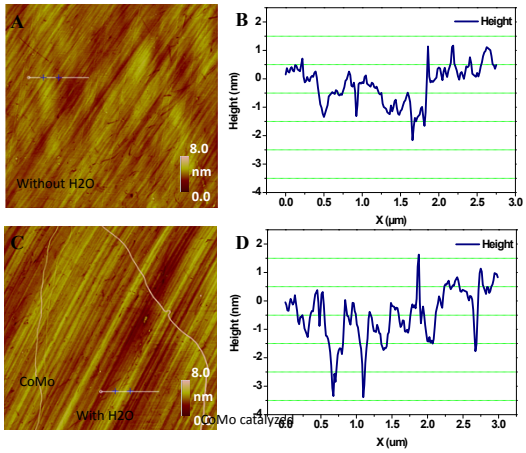


Figure S4. AFM images of SWNTs grown on quartz substrate by using CoMo-w (A), CoMo (C) as catalyst respectively; and corresponding section analysis results of the substrate morphology with(D) and without(B) water during catalyst annealing process. The AFM image sizes are 8 × 8 um. The section plot shows the height profile of selected area between the blue crosses on the white line in AFM image. The section analysis line was drawn based on the scan direction of the AFM probes.

V. Raman characterization of SWNTs on quartz substrate.

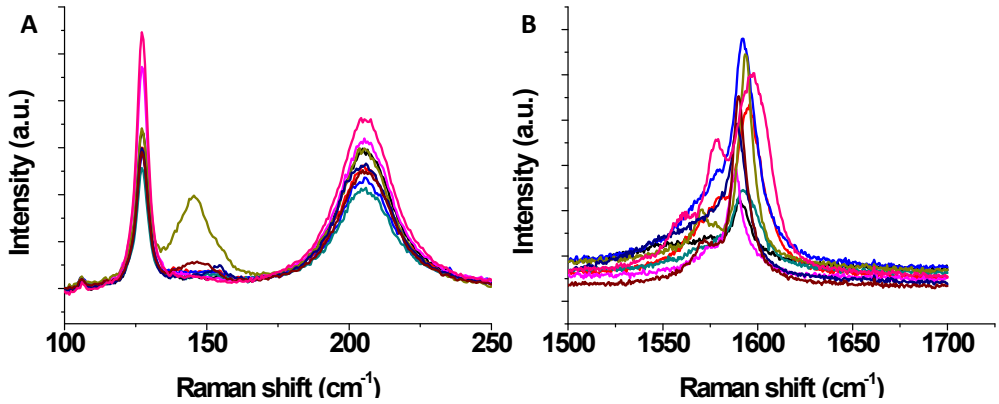
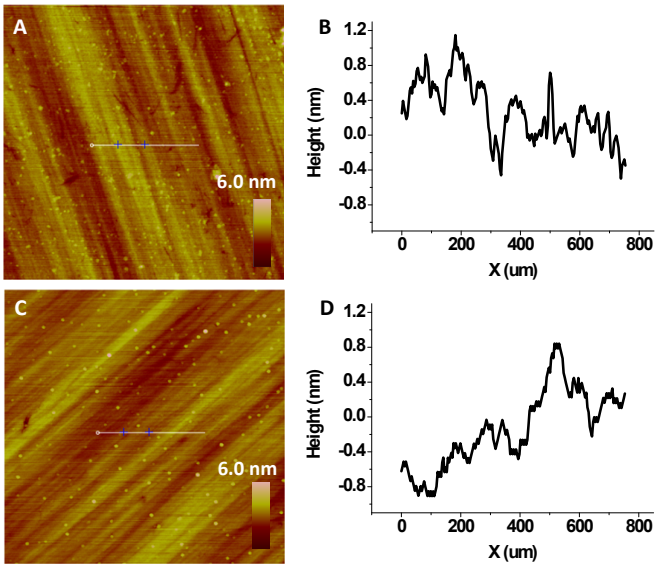
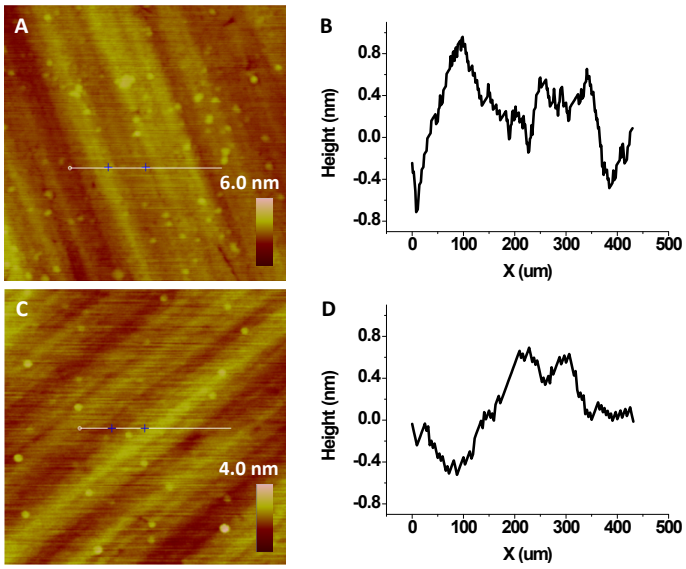


Figure S5. The Raman spectra of SWNTs grown by Co1Mo3-w catalyst. The excitation was 633 nm laser. (A) RBM region; and (B) G-band.

VI. Investigation of influence of annealing on surface morphology of quartz substrate.



Firgure S6. AFM images and corresponding section analysis results of the substrate morphology of quartz substrate before (A, B) and after (C, D) the annealing process. The AFM image sizes are 2 × 2 um. The section plot shows the height profile of selected area along the white line in AFM image. The section analysis line was drawn based on the scan direction of the AFM probes. The randomly distributed particles were contaminant adsorbed on the substrate after being stored for long time.



Firgure S7. AFM images and corresponding section analysis results of the substrate morphology of quartz substrate before (A, B) and after (C, D) the annealing process. The AFM image sizes are 800 × 800 nm. The section plot shows the height profile of selected area along the white line in AFM image. The section analysis line was drawn based on the scan direction of the AFM probes. The randomly distributed particles were contaminant adsorbed on the substrate after being stored for long time.

Notes and references

1. L. Jiao, B. Fan, X. Xian, Z. Wu, J. Zhang and Z. Liu, *Journal of the American Chemical Society*, 2008, **130**, 12612-12613.