

Supporting Information

Aqeel Hussain^a, Er-Xiong Ding^a, Ben McLean^b, Kimmo Mustonen^c, Saeed Ahmad^a, Mohammad Tavokkali^a, Alister J. Page^b, Qiang Zhang^{*a}, Jani Kotakoski^c, Esko I. Kauppinen ^{*a}

Scalable Growth of Single-Walled Carbon Nanotubes with Highly Uniform Structure

a. Department of Applied Physics, Aalto University School of Science, P.O. Box 15100, FI-00076 Aalto, Finland

b. School of Environmental & Life Sciences, University of Newcastle, Callaghan 2308 Australia.

c. Faculty of Physics, University of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria.

Keywords: Selective Growth, water assisted, carbon nanotubes, chirality

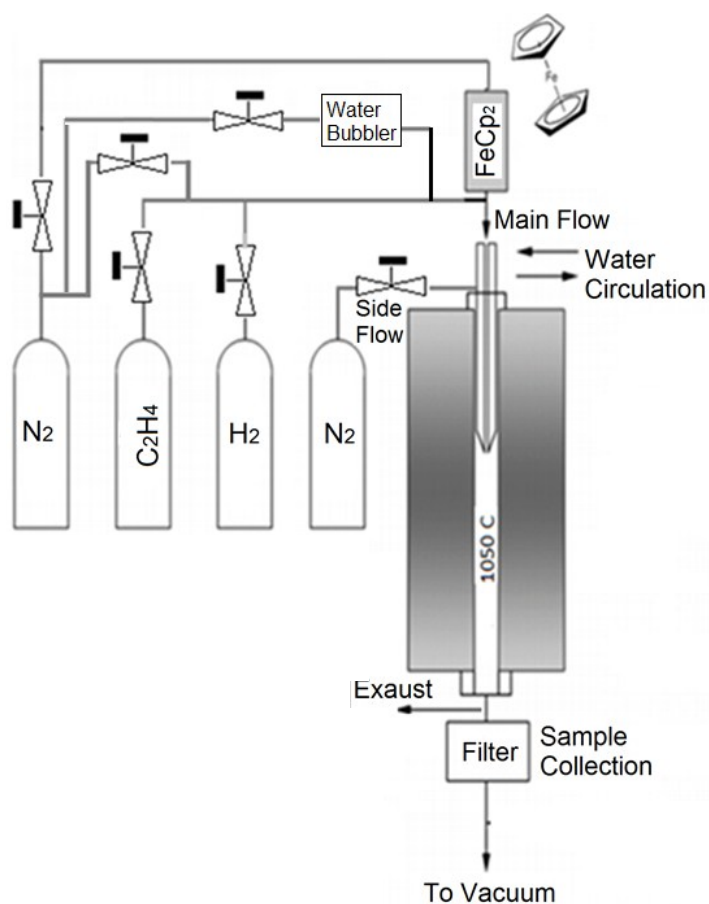


Figure S1 Schematic of floating catalyst CVD synthesis of SWCNTs with the addition of water.

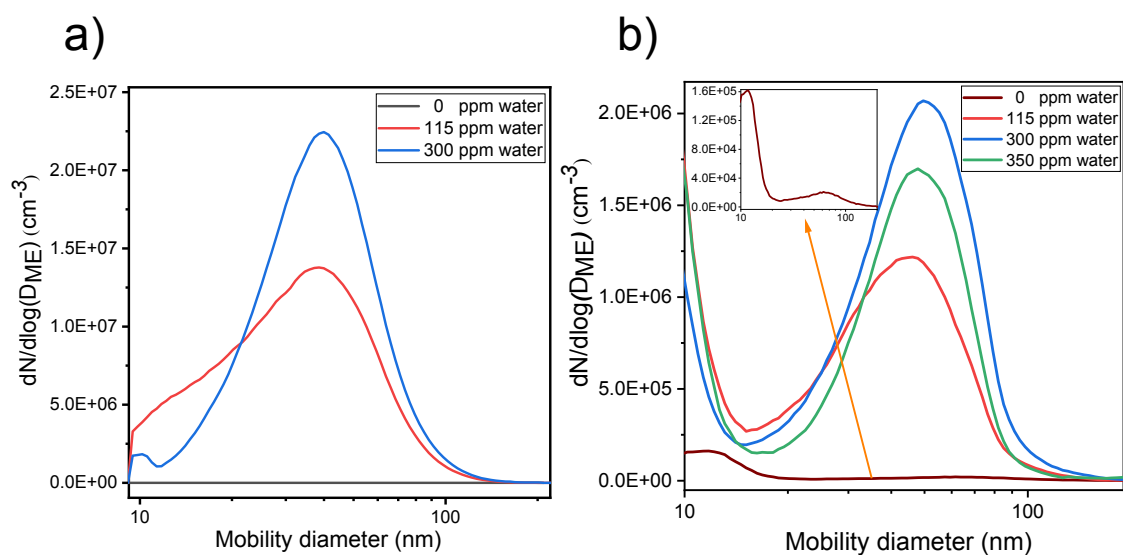


Figure S2 DMA measurement of variation in the number size distribution of a) Nanoparticles (NPs) and b) SWCNTs.

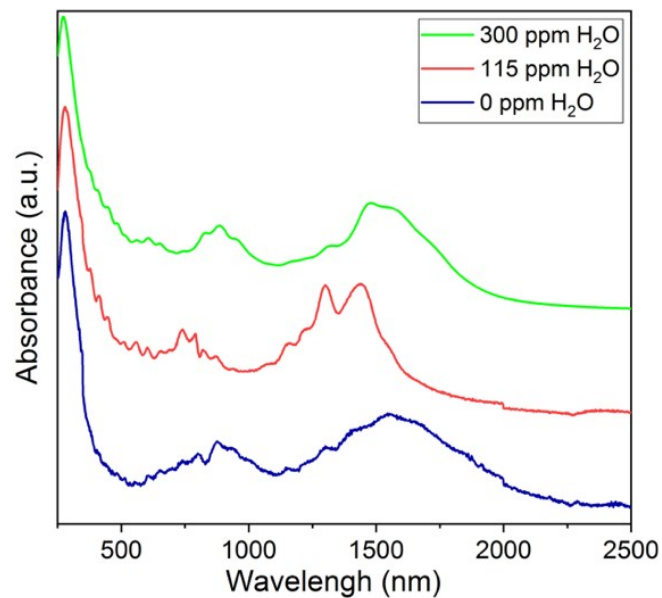


Figure S3 Absorption spectra of SWCNTs grown at 0 ppm H₂O, 115 ppm H₂O and 300 ppm water.

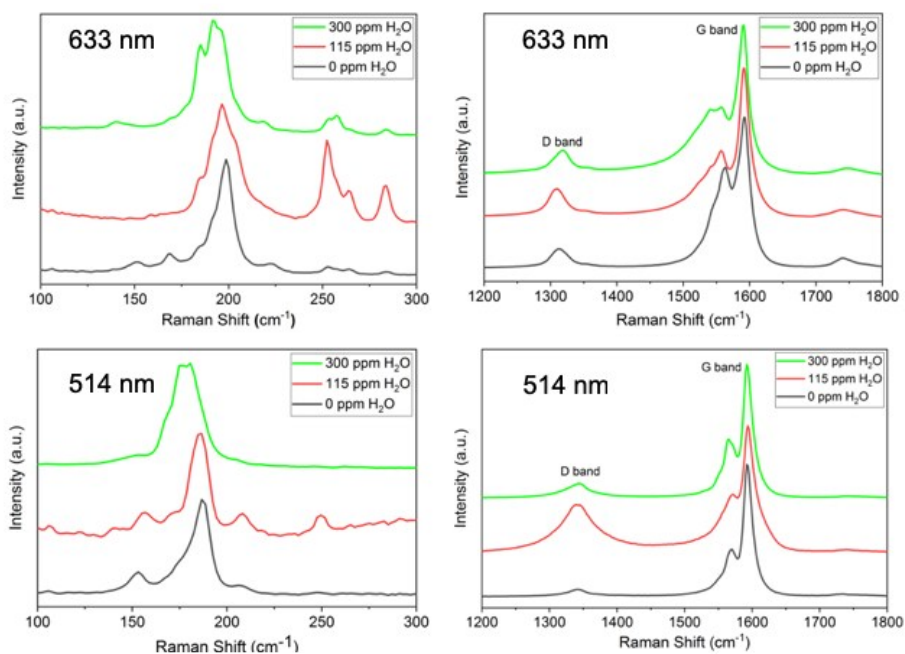


Figure S4 Raman spectroscopy for the synthesis of SWCNTs at 0 ppm H₂O, 115 ppm H₂O and 300 ppm H₂O.

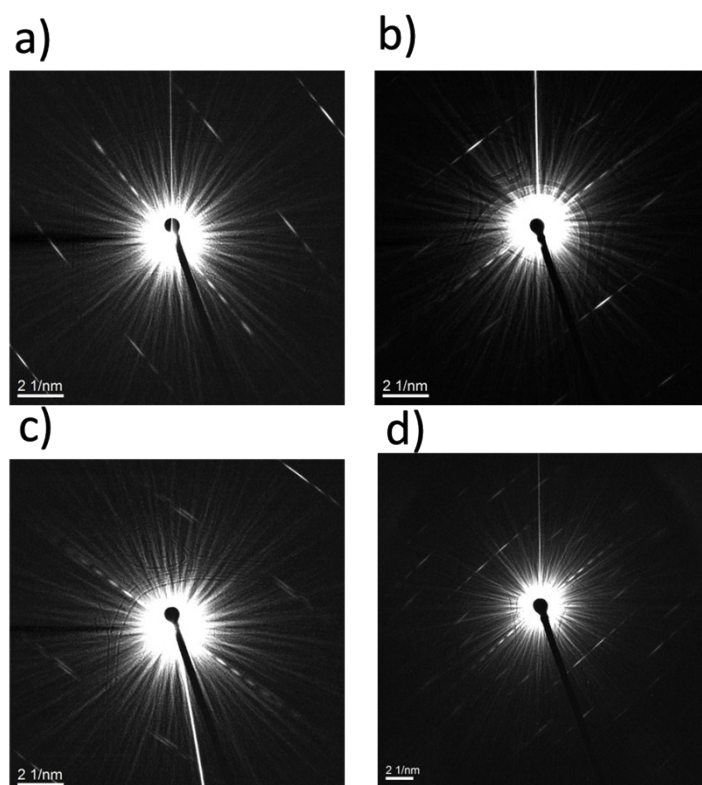


Figure S5 The diffraction pattern of a) armchair, b) zigzag, c) near armchair and d) chiral SWCNTs.

Table S1. Variation in SWCNT chiral angles and diameters as well as the maximum enrichment values of a single chirality nanotube produced by FCCVD as reported in the literature and as observed in our work.^{1,2,3,4,5}

Carbon source and promoter	Chiral Angle (Standard Deviation) degree	Diameter (Standard Deviation) nm	Maximum Enrichment of Single Chirality	Reference
C ₂ H ₅ OH	20.00 ± 7.99	1.67 ± 0.22	4.7% of (14,9)	1
CO, 0.25% CO ₂	23.25 ± 5.80	1.25 ± 0.12	8.33% of (9,8)	2
CO, 0% CO ₂	23.50 ± 4.90	1.07 ± 0.17	13.33% of (8,7)	2
CO, CO ₂ at 880 C	----	1.35 ± 0.072	17% of (11,8)	3
CO, 500 ppm NH ₃	----	----	10% of (13,12)	4
C ₂ H ₄	13.00 ± 9.00	1.50 ± 0.27	5.7% of (12,9)	5
C ₂ H ₄ , 300 ppm H ₂ O	25.35 ± 4.11	1.20 ± 0.15	11% of (9,8)	Current Work
C ₂ H ₄ , 115 ppm H ₂ O	25.92 ± 4.97	1.10 ± 0.12	27% of (9,8)	Current Work

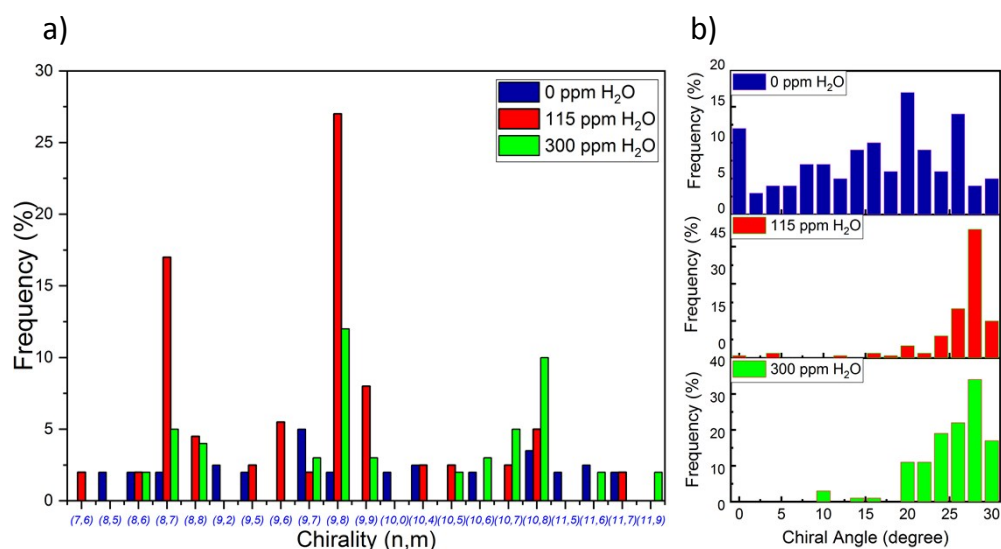


Figure S6 a) SWCNT chirality distribution counting all chiralities with more than 2% abundance. b) chiral angle distributions at 0 ppm H₂O, 115 ppm H₂O and 300 ppm H₂O.

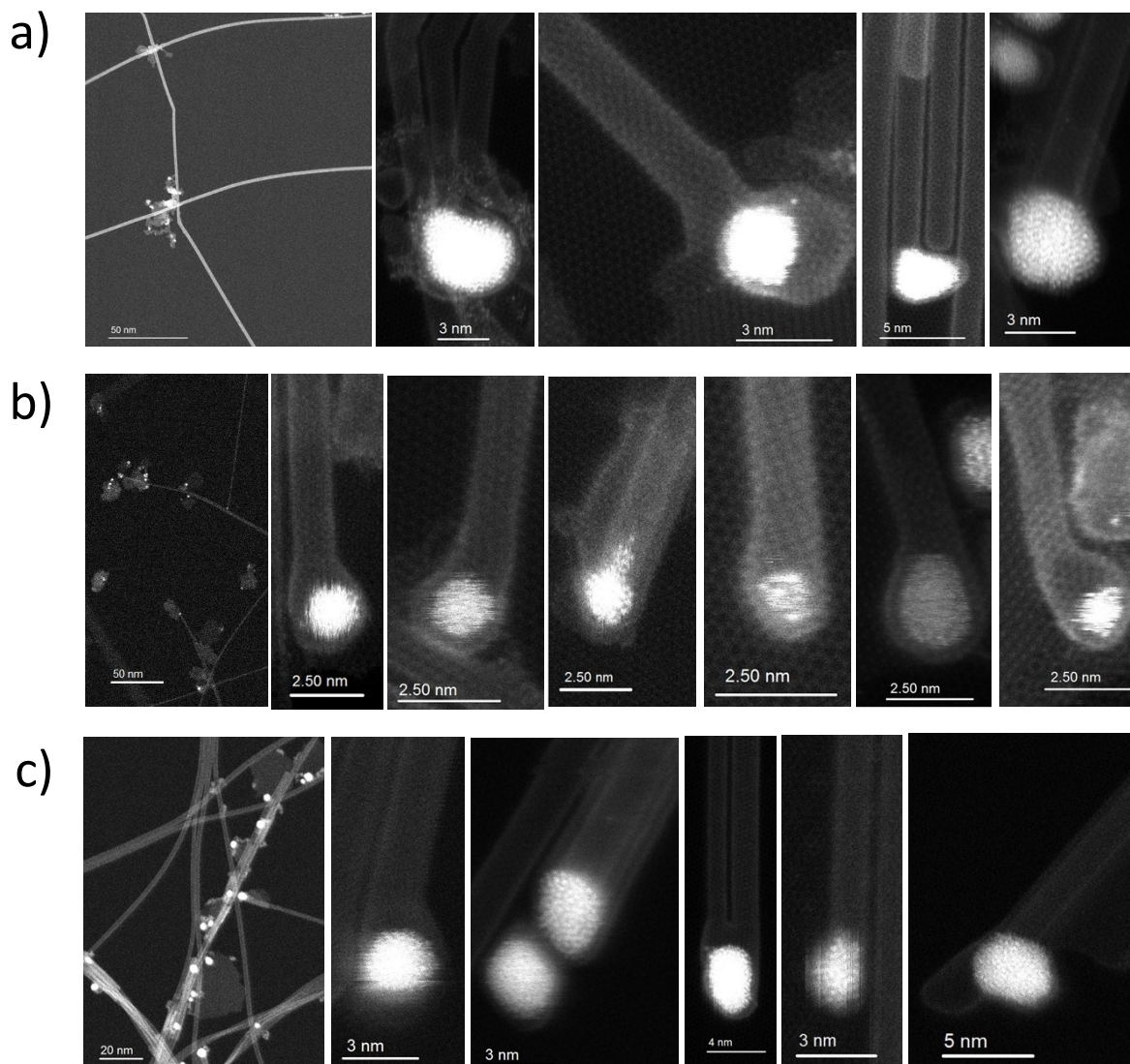


Figure S7 Scanning transmission electron microscope (STEM) images of NPs of SWCNTs grown at a) 0 ppm water, b) 115 ppm water and 300 ppm water.

References

- 1 E. X. Ding, H. Jiang, Q. Zhang, Y. Tian, P. Laiho, A. Hussain, Y. Liao, N. Wei and E. I. Kauppinen, *Nanoscale*, 2017, **44**, 17601-17609.
- 2 Y. Liao, H. Jiang, N. Wei, P. Laiho, Q. Zhang, S. A. Khan and E. I. Kauppinen, *J. Am. Chem. Soc.*, 2018, **31**, 9797-9800.
- 3 Y. Tian, H. Jiang, P. Laiho and E. I. Kauppinen, *Anal. Chem.*, 2018, **4**, 2517-2525.
- 4 Z. Zhu, H. Jiang, T. Susi, A. G. Nasibulin and E. I. Kauppinen, *J. Am. Chem. Soc.*, 2011, **5**, 1224-1227.
- 5 A. Hussain, Y. Liao, Q. Zhang, E. X. Ding, P. Laiho, S. Ahmad, N. Wei, Y. Tian, H. Jiang and E. I. Kauppinen, *Nanoscale*, 2018, **10**, 9752-9759.
