

Supplementary Materials for

Growth kinetics of single-walled carbon nanotubes with a $(2n, n)$ chirality selection

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Other Supplementary Material for this manuscript includes the following:

(available at advances.sciencemag.org/cgi/content/full/5/12/eaav9668/DC1)

Movie S1 (.mp4 format). In situ observation of SWCNT growth.

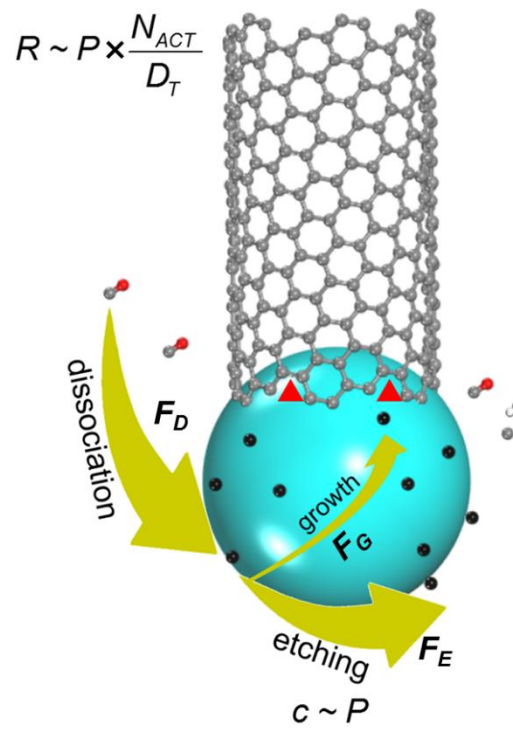
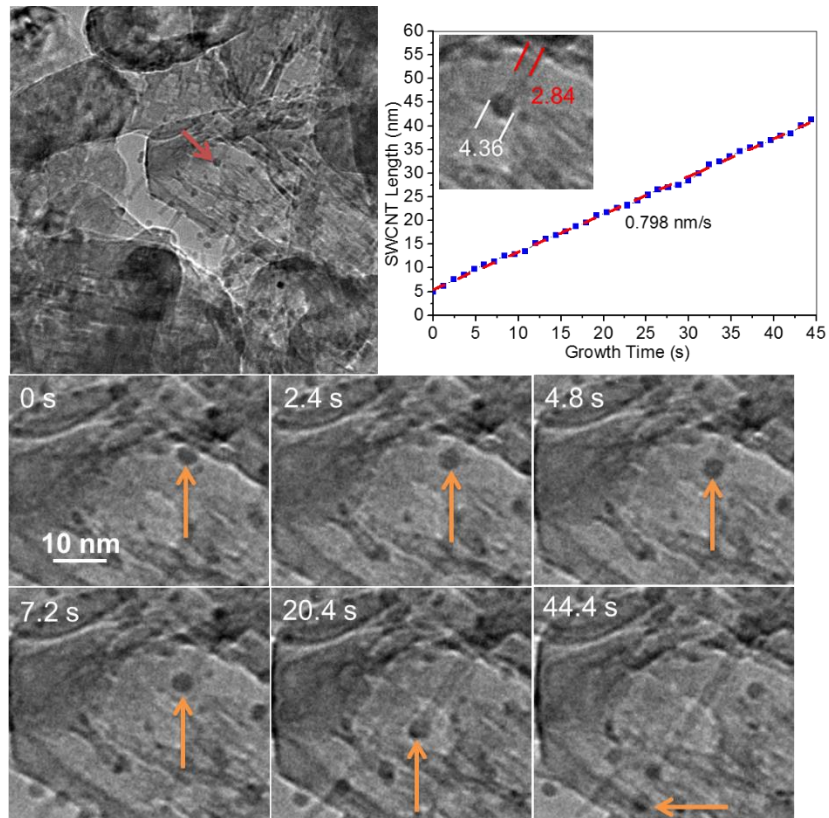
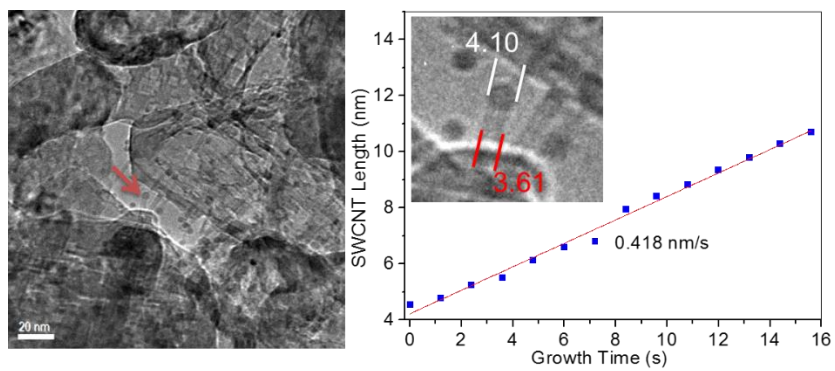


Fig. S1. Model of SWCNT growth following a screw dislocation theory. Schematic illustration of SWCNT growth in the presence of efficient etching agents. The SWCNT growth follows a screw dislocation theory.

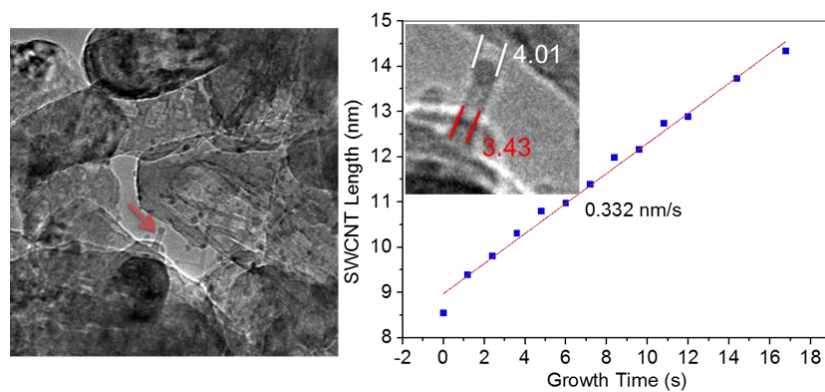
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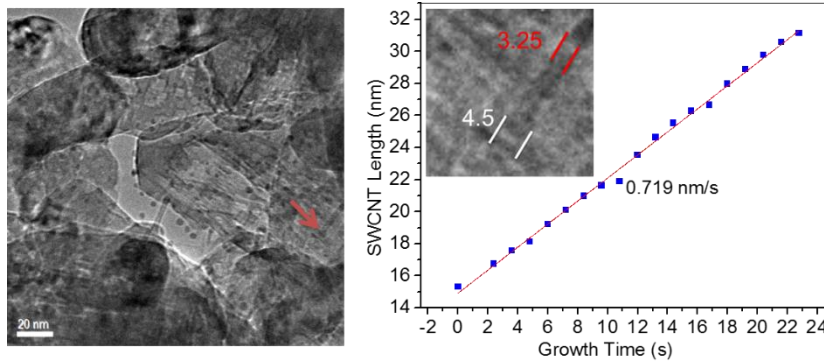
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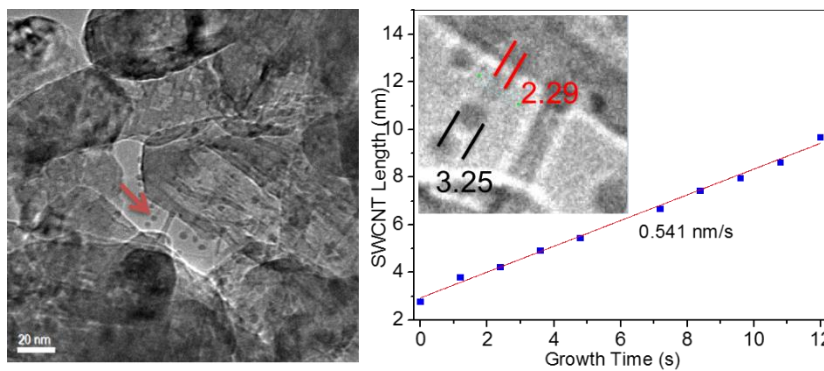
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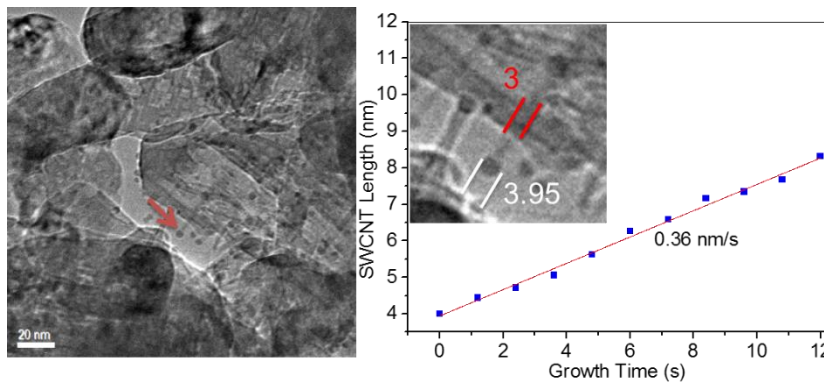
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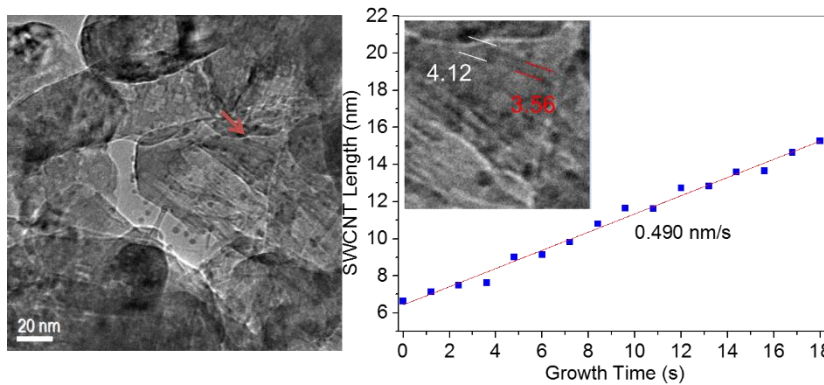
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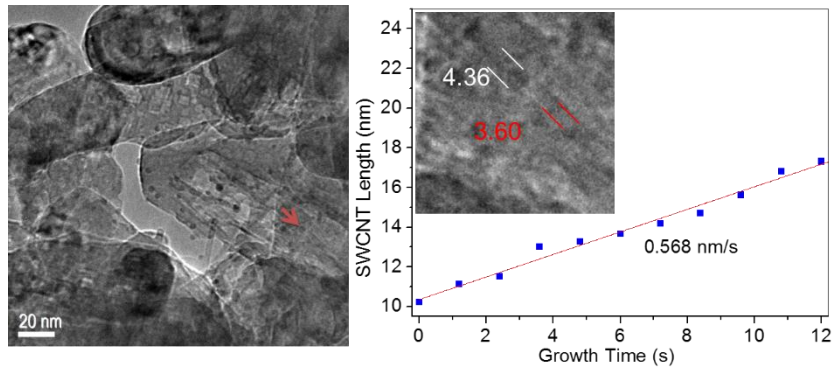
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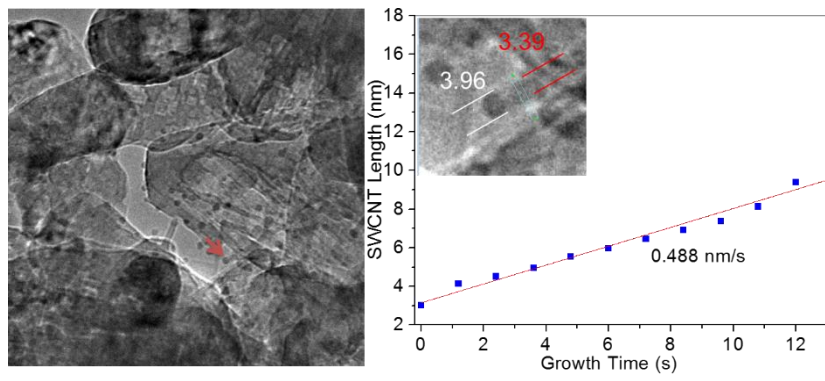
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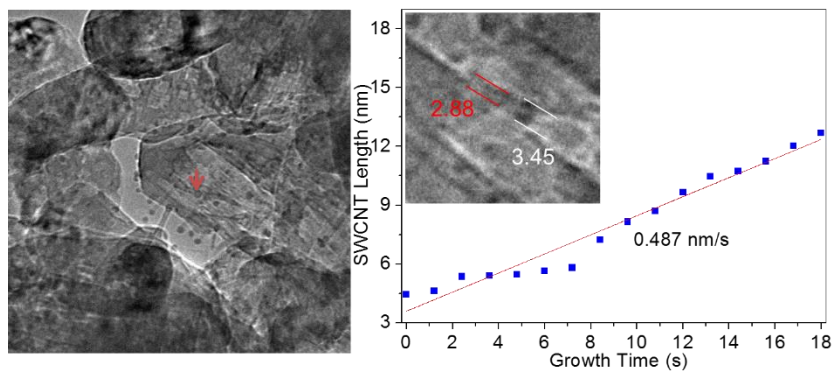
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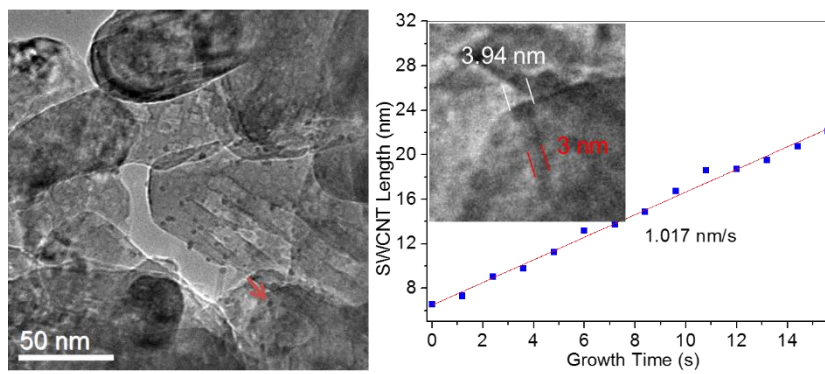
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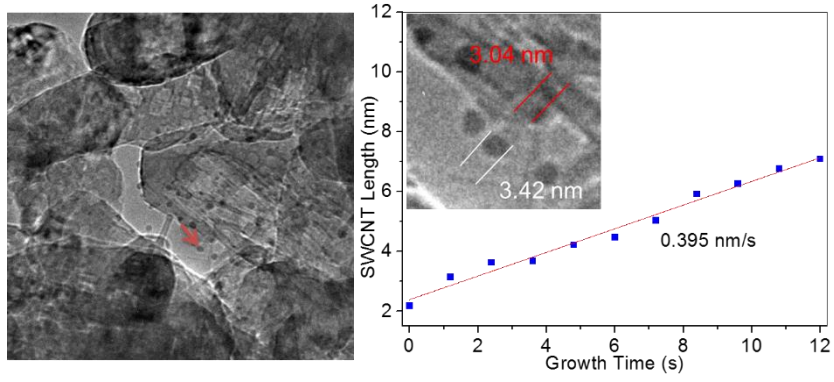
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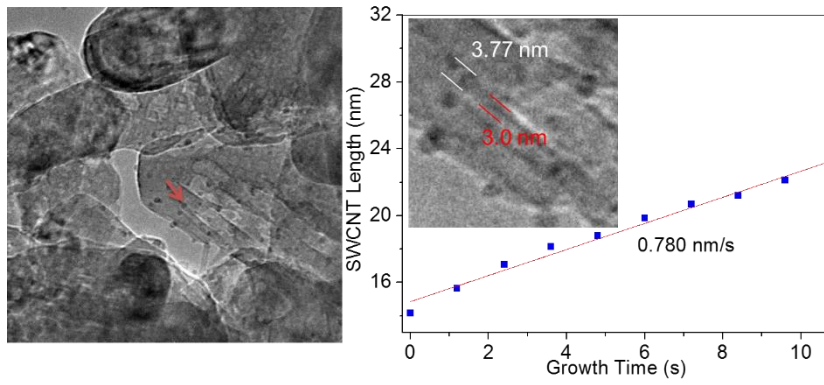
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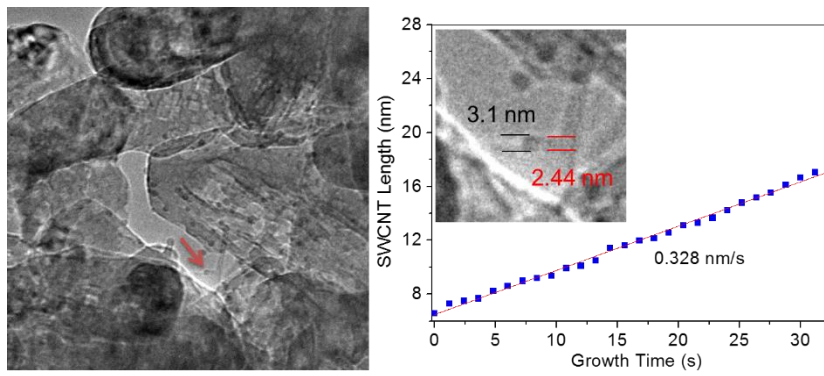
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m) #14:



n) #15:



o) #16:

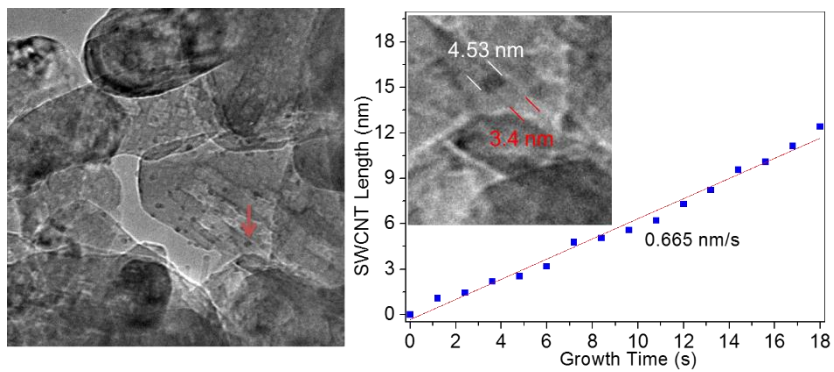


Fig. S2. Investigated SWCNTs (marked with arrows) and calculated growth rates. SWCNT TEM images and growth rates derived by fitting the plots of SWCNT lengths against growth time. All the units for measured diameter are nm.

Table S1. Growth rates and corresponding parameters of SWCNTs and catalysts for 16 different SWCNTs.

SWCNT Sample	SWCNT diameter (D_T , nm)	Catalyst particle size (D_C , nm)	Exposed catalyst surface area (A , nm ²)	SWCNT growth rate (R_T , nm/s)
#1	3.57	4.14	40.56	0.302
#2	2.84	4.36	52.52	0.798
#3	3.61	4.1	38.92	0.418
#4	3.43	4.01	38.34	0.332
#5	3.25	4.5	53.81	0.719
#6	2.29	3.25	28.36	0.541
#7	2.89	3.75	40.45	0.36
#8	3.56	4.12	40.08	0.49
#9	3.6	4.36	46.71	0.568
#10	3.39	3.96	37.36	0.488
#11	2.88	3.45	28.99	0.487
#12	3.04	3.42	26.79	0.395
#13	2.83	3.77	37.08	0.78
#14	2.44	3.1	24.41	0.328
#15	3.4	4.53	53.53	0.665
#16	3	4.34	50.97	0.559

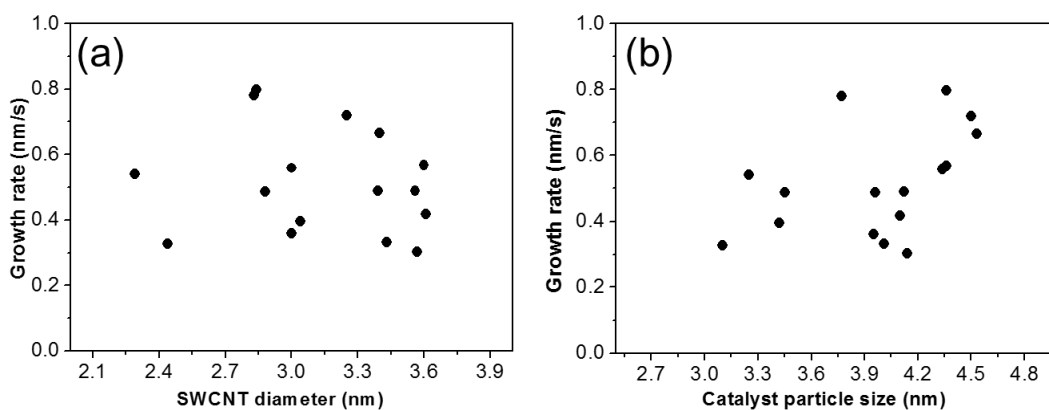


Fig. S3. SWCNT growth rate plots against tube diameter and catalyst size. SWCNT growth rate is plotted as a function of (a) SWCNT diameter; (b) catalyst particle size.

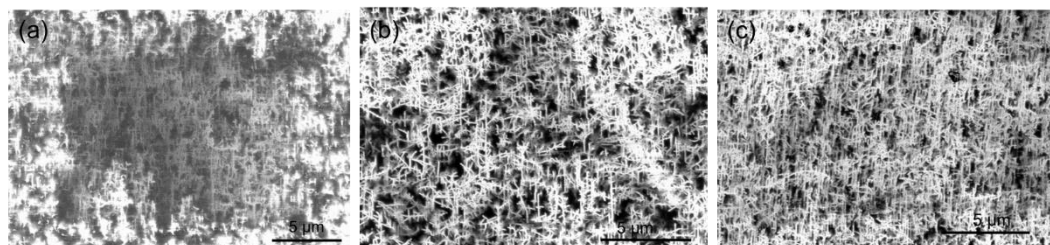


Fig. S4. SEM images of carbon nanotubes grown on quartz-supported Co catalyst. Scanning electron microscopy images of carbon nanotubes grown on quartz supported Co catalysts by CVD in 300 sccm Ar using different flow rate of CO: (a) 30 sccm; (b) 40 sccm; (c) 50 sccm.

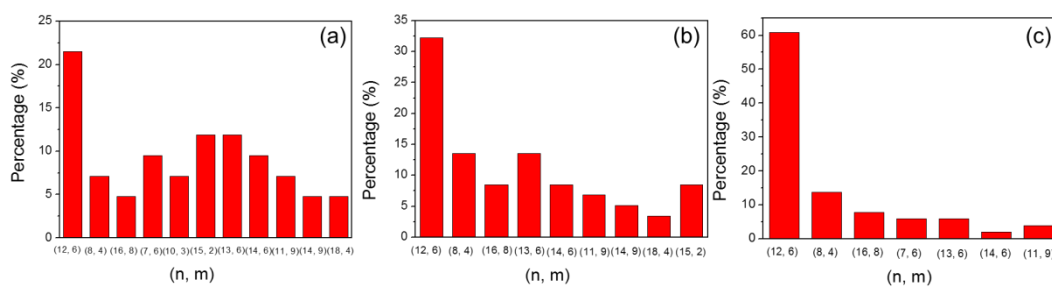


Fig. S5. Chirality distribution histograms of SWCNTs grown on Co particles with different CO fluxes. Chirality distribution histograms of SWCNTs grown on Co particles with different CO flux. (a) 30 sccm; (b) 40 sccm; (c) 50 sccm.

Table S2. (n, m) populations of SWCNTs grown on Co catalyst using different flow rates of CO.

Chirality (n, m)	Abundance		
	30 sccm CO	40 sccm CO	50 sccm CO
(12, 6)	21.5%	32.2%	60.8%
(8, 4)	7.1%	13.5%	13.7%
(16, 8)	4.8%	8.5%	7.8%
(7, 6)	9.5%	0	5.9%
(10, 3)	7.1%	0	0
(15, 2)	11.9%	8.5%	0
(13, 6)	11.9%	13.5%	5.9%
(14, 6)	9.5%	8.5%	2.0%
(11, 9)	7.1%	6.8%	3.9%
(14, 9)	4.8%	5.1%	0
(18, 4)	4.8%	3.4%	0

Table S3. Chirality distribution of SWCNTs grown on Mo₂C using different ratios of ethanol and H₂. The abundance of different SWCNT species is determined by Raman spectroscopy.

Chirality	Abundance				
	E:H=100:0	E:H=100:10	E:H=100:50	E:H=100:100	E:H=100:200
(12,6)	87%	68.6%	37.7%	24.5%	17.1%
(12,8)	4.8%	3.8%	13.0%	11.8%	13.0%
(16,8)	3.3%	5.1%	7.2%	12.7%	10.3%
(8,4)	3.3%	3.8%	5.1%	3.6%	2.1%
(10,5)	1.6%	1.9%	0.7%	1.8%	0.7%
(18,6)	0	1.9%	5.1%	10.9%	11.0%
(12,4)	0	6.4%	10.1%	9.1%	8.2%
(9,8)	0	1.9%	4.3%	5.5%	4.8%
(10,8)	0	3.2%	0.7%	0.9%	4.1%
(11,8)	0	1.9%	2.2%	1.8%	6.8%
(15,2)	0	1.3%	7.2%	7.3%	10.3%
(6,4)	0	0	0.7%	0.9%	0.7%
(9,7)	0	0	5.8%	1.8%	2.1%
(8,1)	0	0	0	0.9%	2.1%
(14,4)	0	0	0	6.4%	6.8%

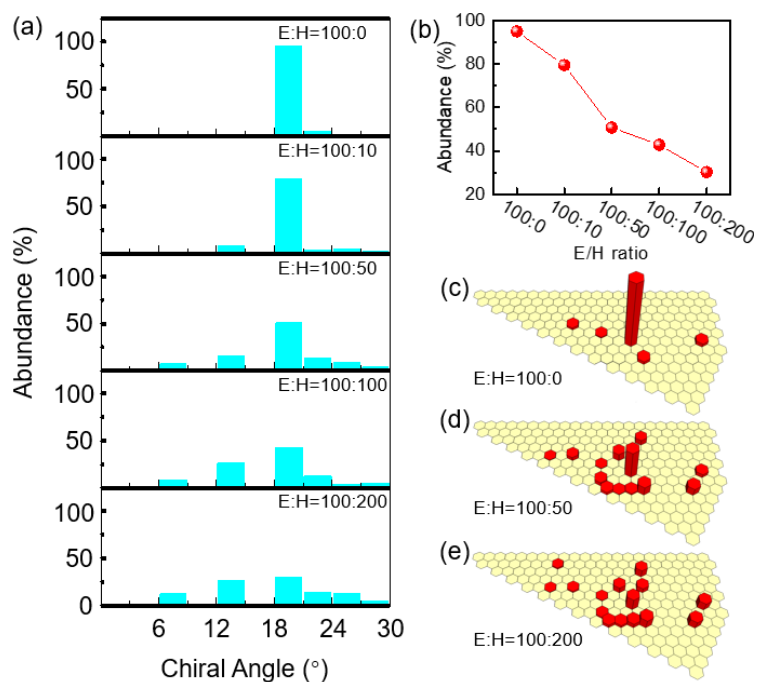


Fig. S6. Chirality evolution and distribution of SWCNTs grown on Mo₂C. (a) the chiral angle distributions of SWCNTs grown from Mo₂C catalyst particles using a mixture of ethanol and H₂ with different E:H ratio at 850 °C. (b) the abundance of (2n, n) SWCNTs and the chirality distributions of SWCNTs grown with ethanol to H₂ (E:H) ratios of (c)100:0, (d) 100:50 and (e)100:200. Note that the (2n, n) SWCNTs include the (12,6) and others, such as (8,4) and (10,5).