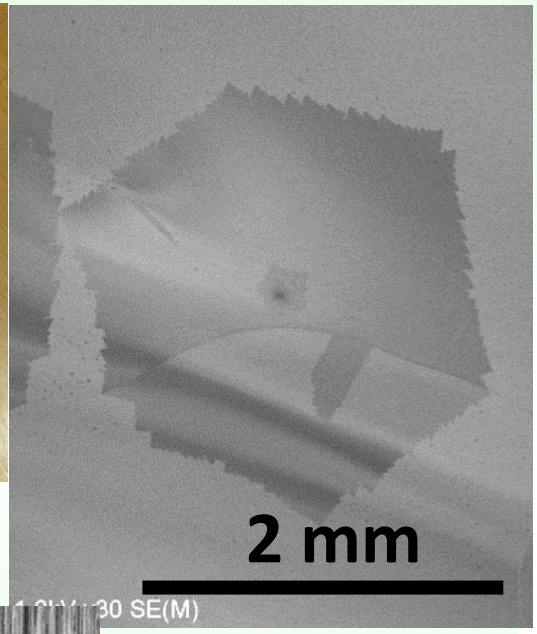
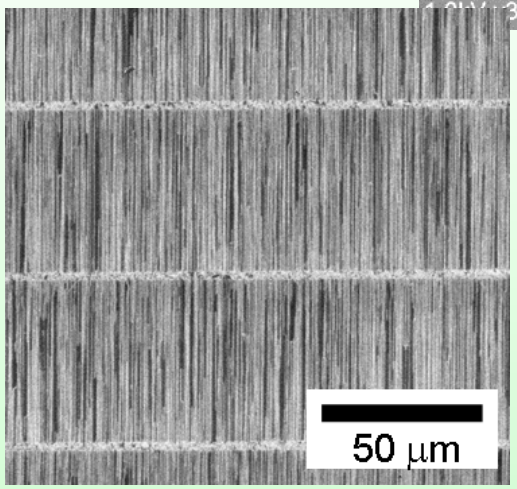
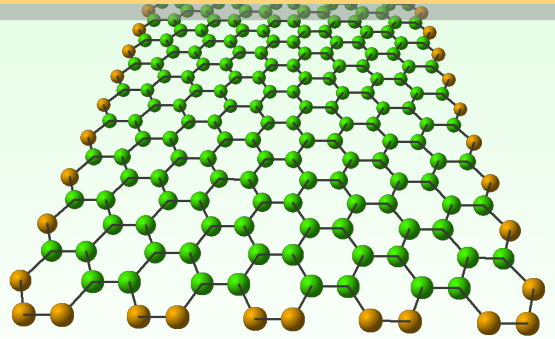
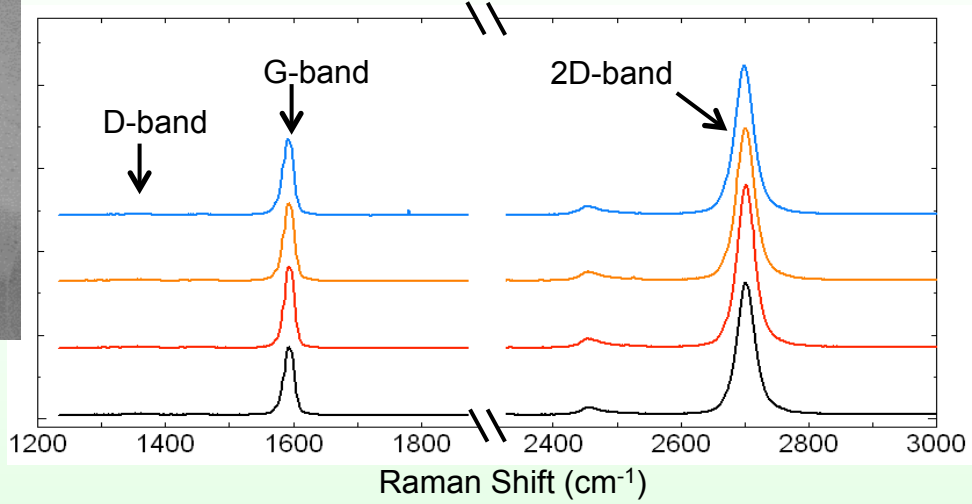
CVD法による均質グラフェンの合成と評価









丸山茂夫　Shigeo Maruyama
東京大学　大学院工学系研究科　機械工学専攻
Department of Mechanical Engineering,
The University of Tokyo (UTokyo)

Carbon Nanotube and Nano-Therm. Lab.

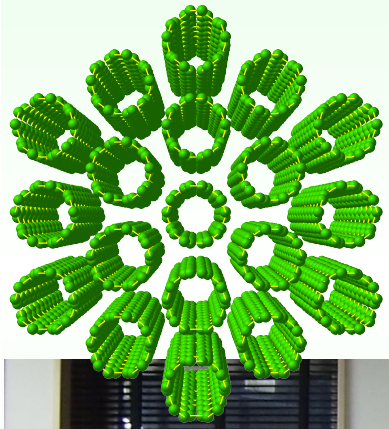
Shigeo Maruyama
丸山 茂夫

Junichiro Shiomi

Shohei Chiashi

James Cannon

Takuma Shiga

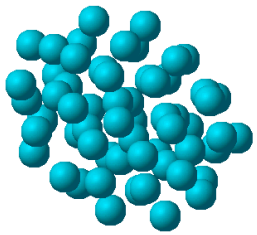


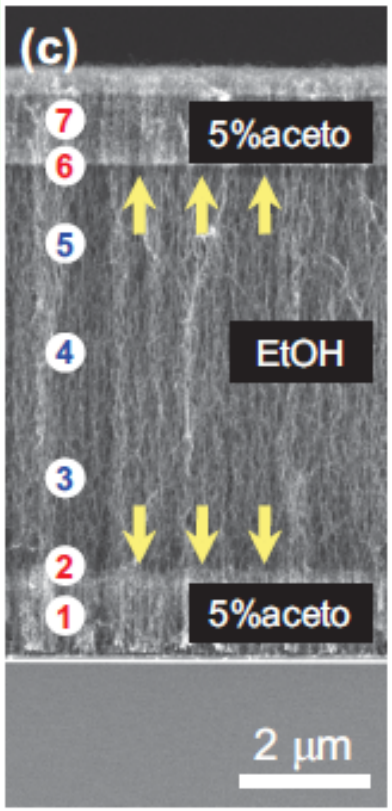
March, 2013

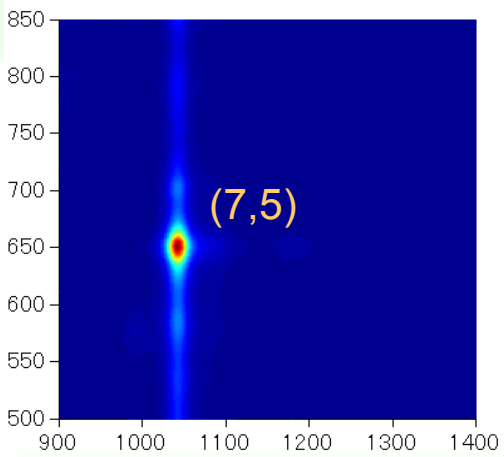
CVD growth of SWNTs and Graphene by ACCVD (Alcohol Catalytic CVD)

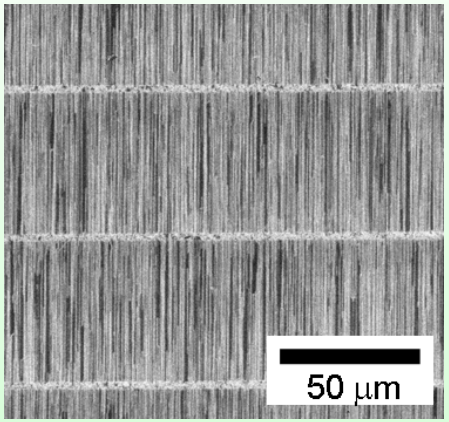
Maiko

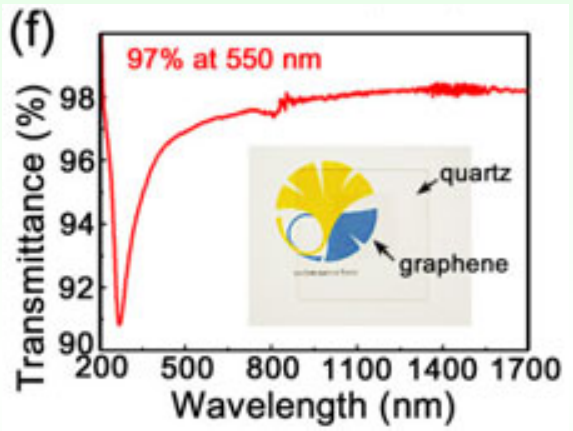
Octopus Growth

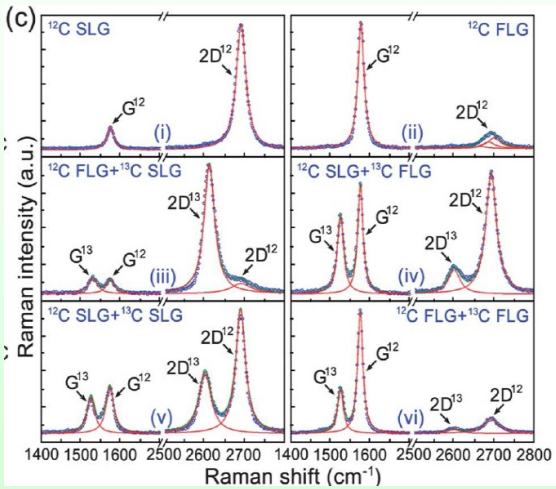




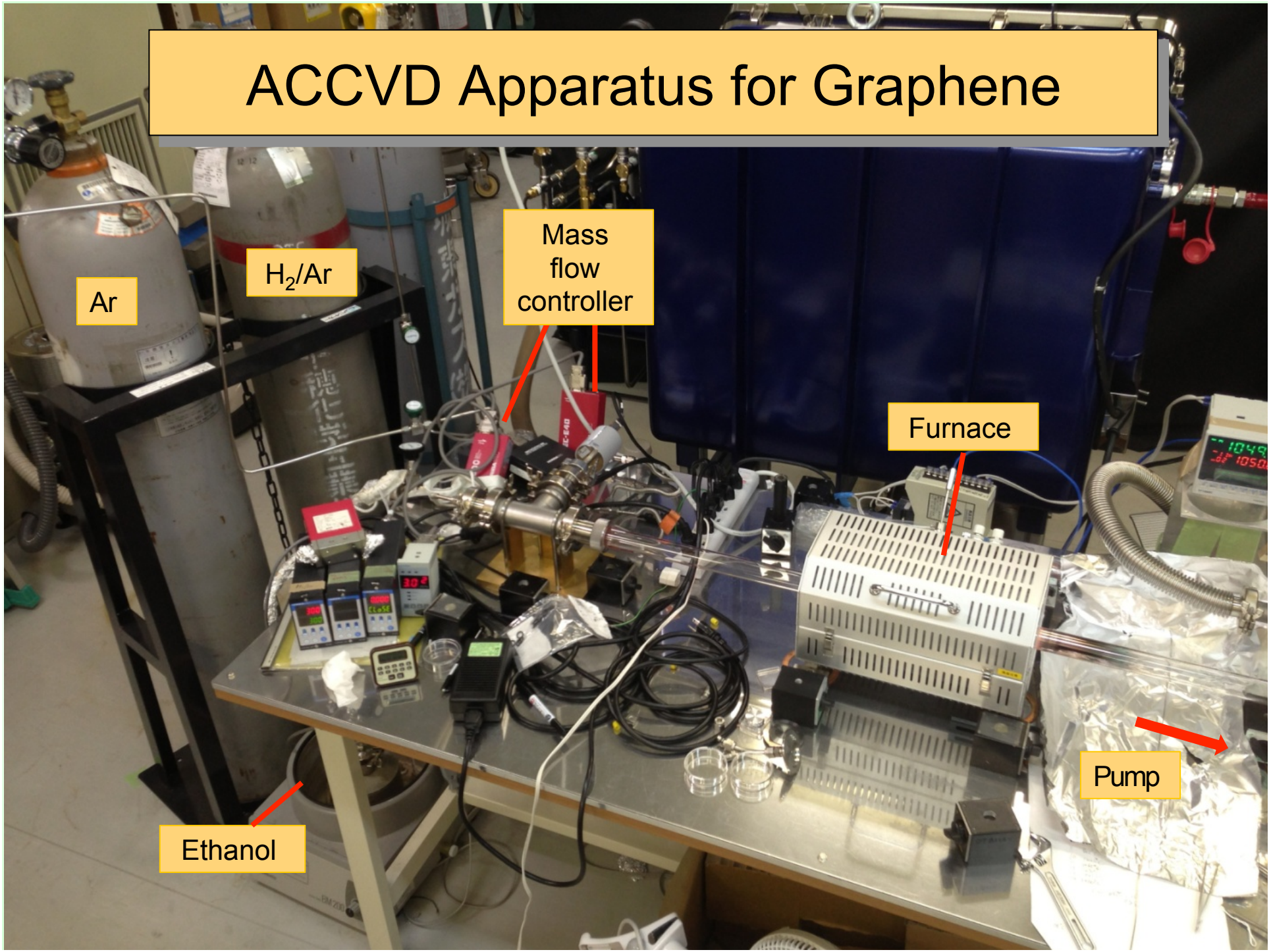




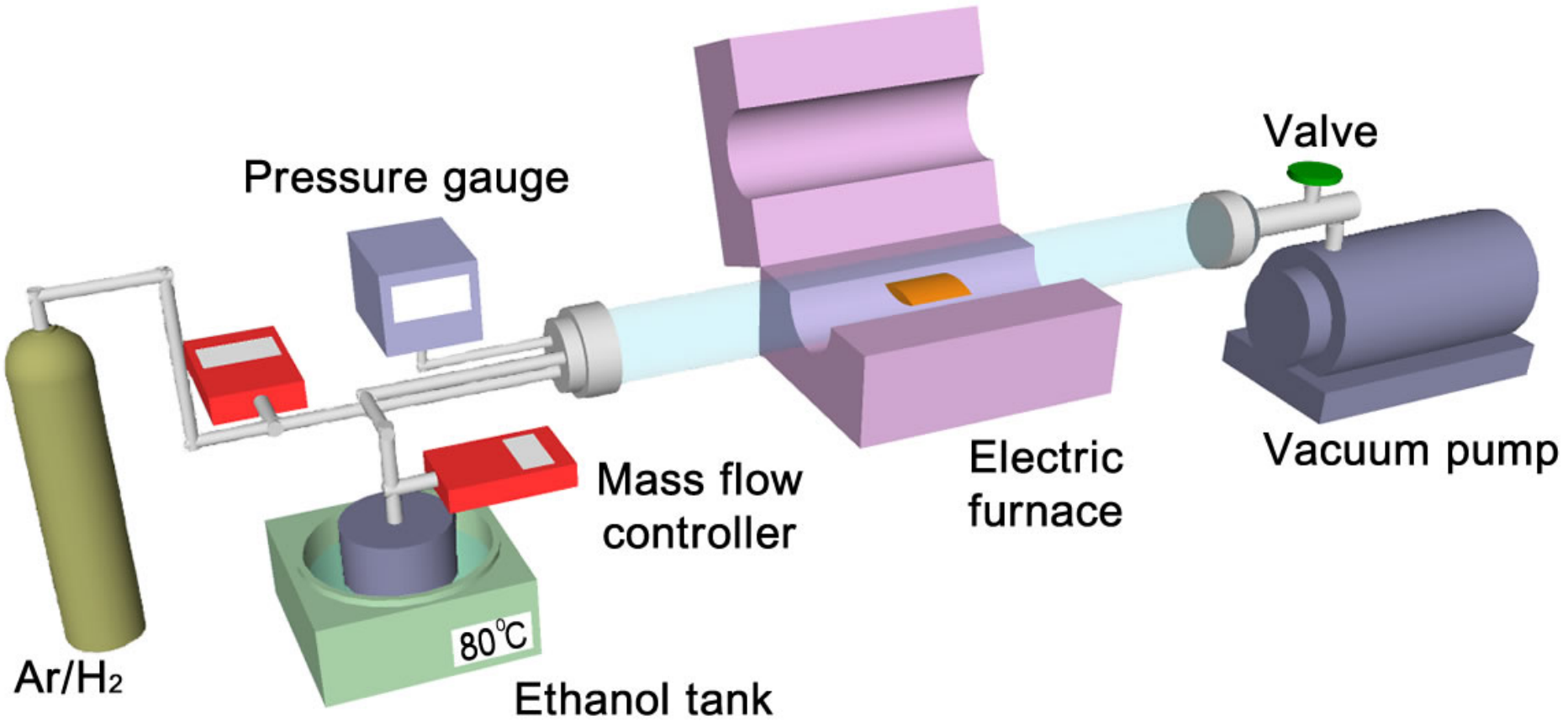




ACCVD Apparatus for Graphene



ACCVD Apparatus



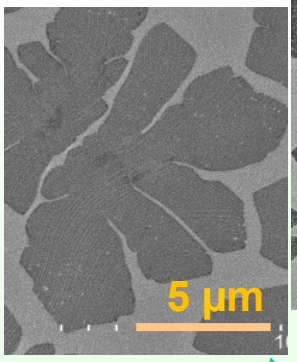
S. Maruyama et al., Chem. Phys. Lett. 403 (2005) 320.

Progress towards large ‘single crystals’ over the past year

Size of single crystals

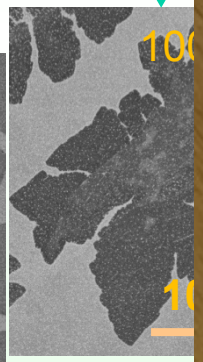
Time

1000 ºC



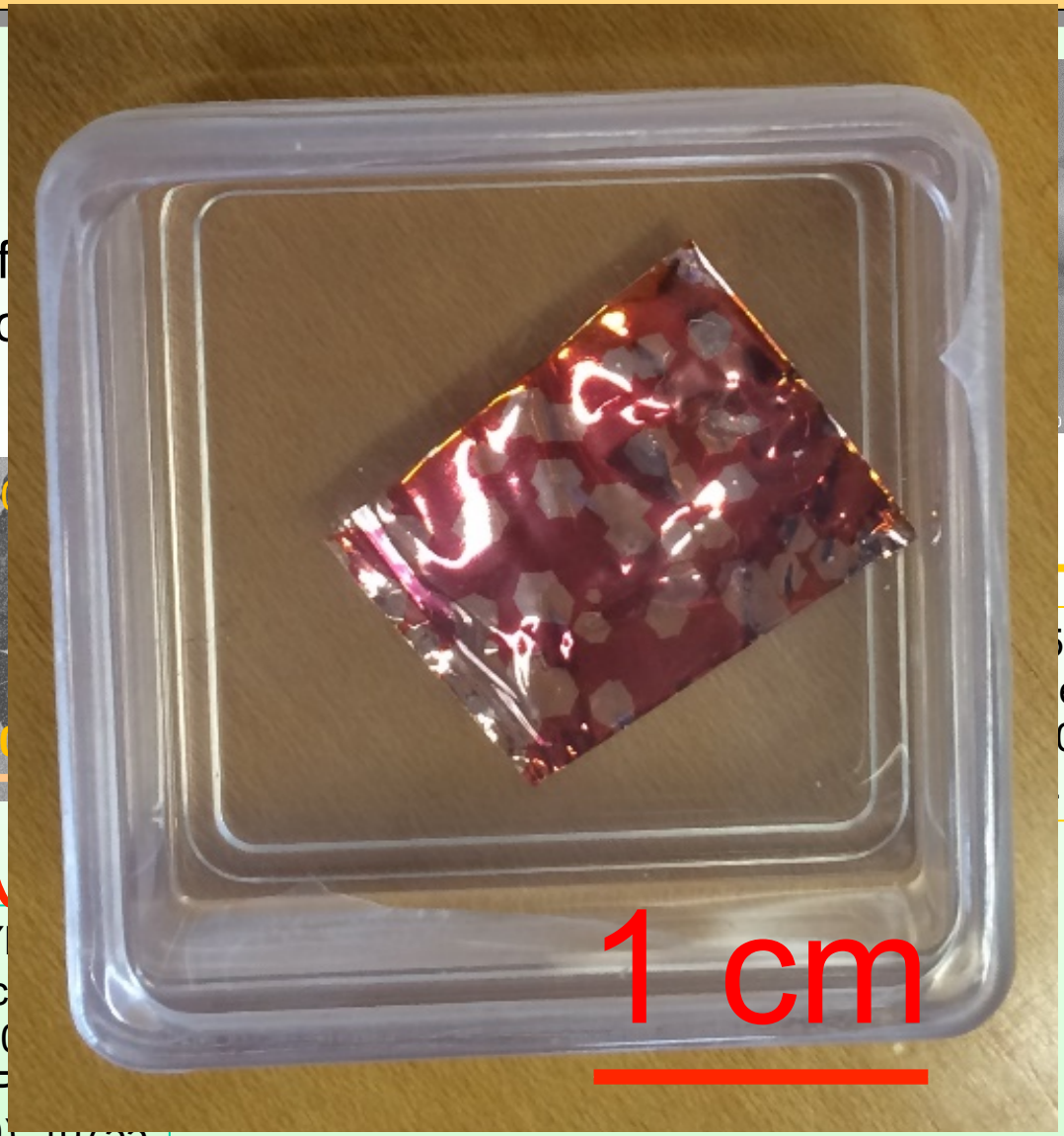
2013.3

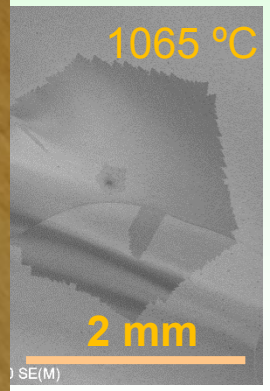
Ethanol f
rate: 5 sc



201

Nippon Denkai Cu foil Y
enclosed, 1000 ºC, 300 sc
Ar + 10 sccm Ethanol, 30
min. P. Zhao, *et al.*, *J. P*
Chem. C, (2013), 117, (20),



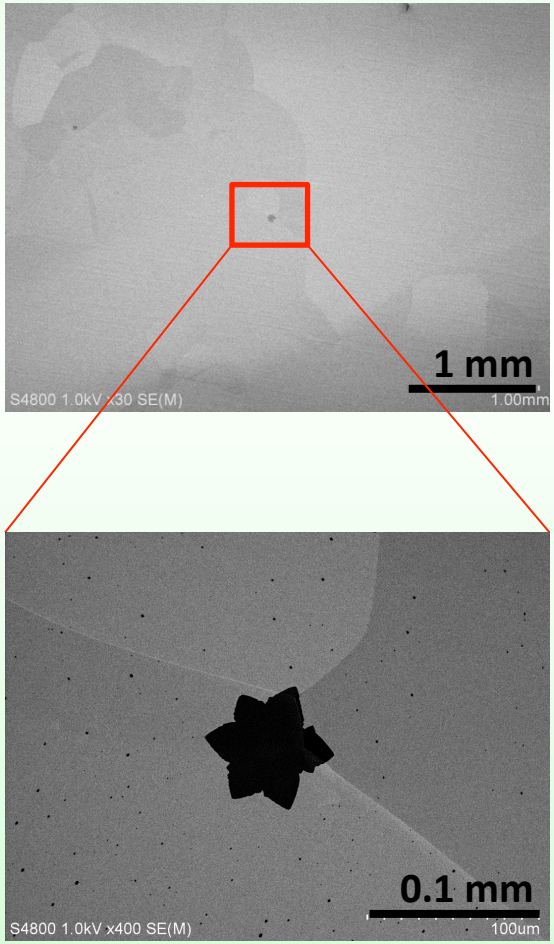


2014.1

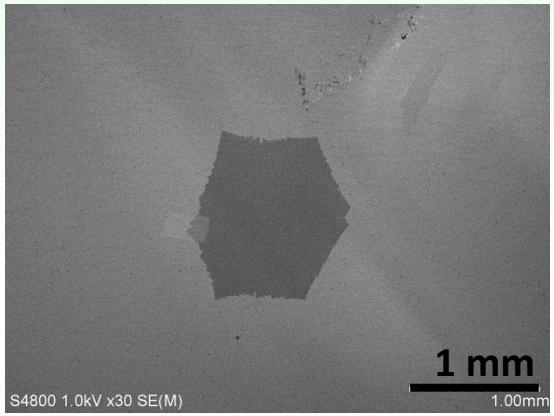
0 µm, pre-
ed, heating
0~1070 ºC,

Growth Acceleration after Reduction

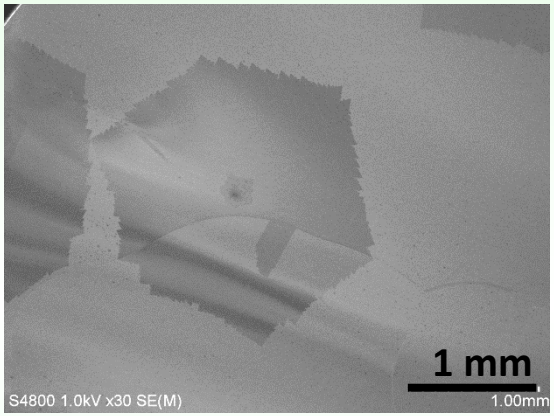
2 hours



8 hours



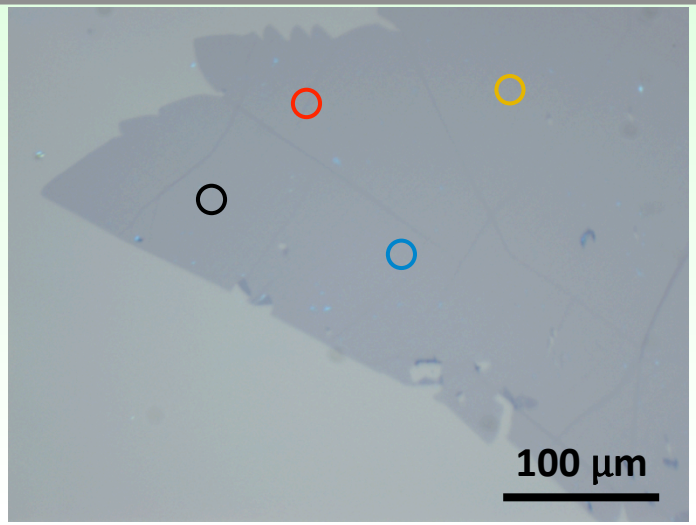
11 hours

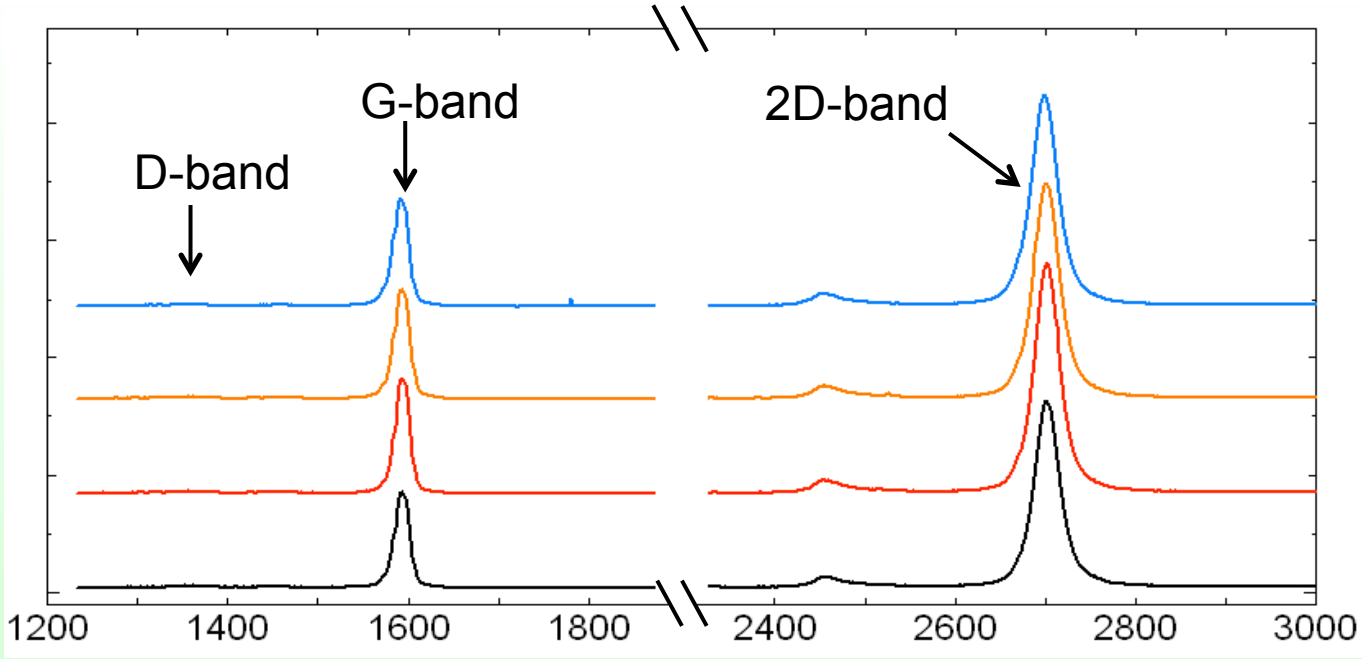


Condition: Nilaco Cu foil 50 μm, enclosed, pre-treatment
CVD @ 1065 ° C, 300sccm Ar/H2 and 0.031sccm EtOH, 300Pa

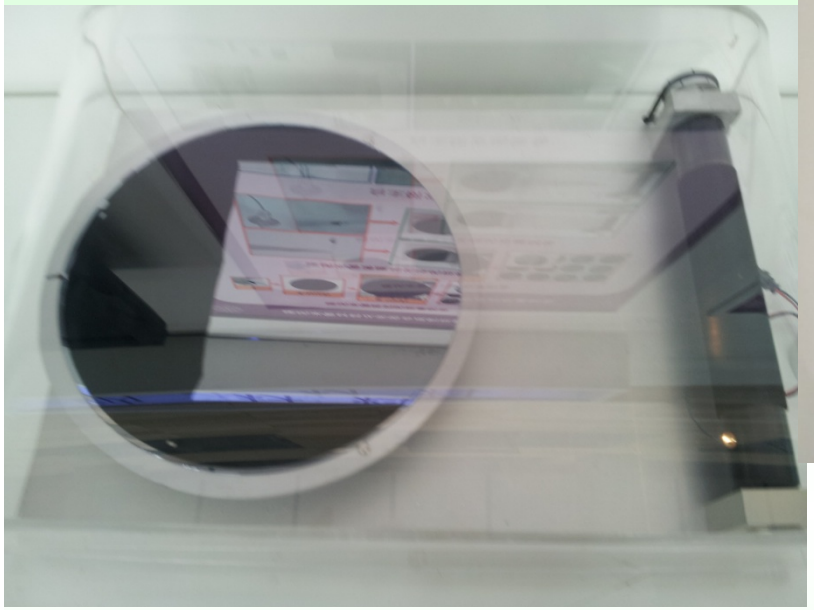
Characterization by Raman

Condition: Nilaco Cu foil 50 μm, enclosed, Pre-treatment, CVD @ 1065° C, 300sccm Ar/H2 and 0.031sccm EtOH, 300Pa, 8 hours.

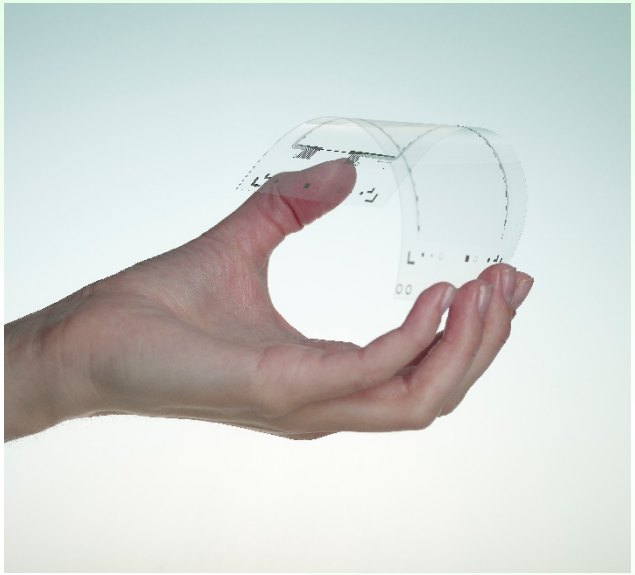


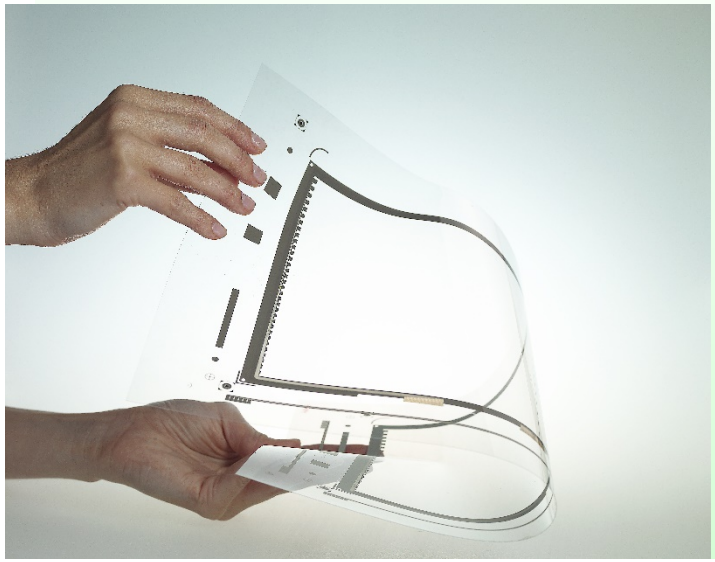


Transparent Conductive Film

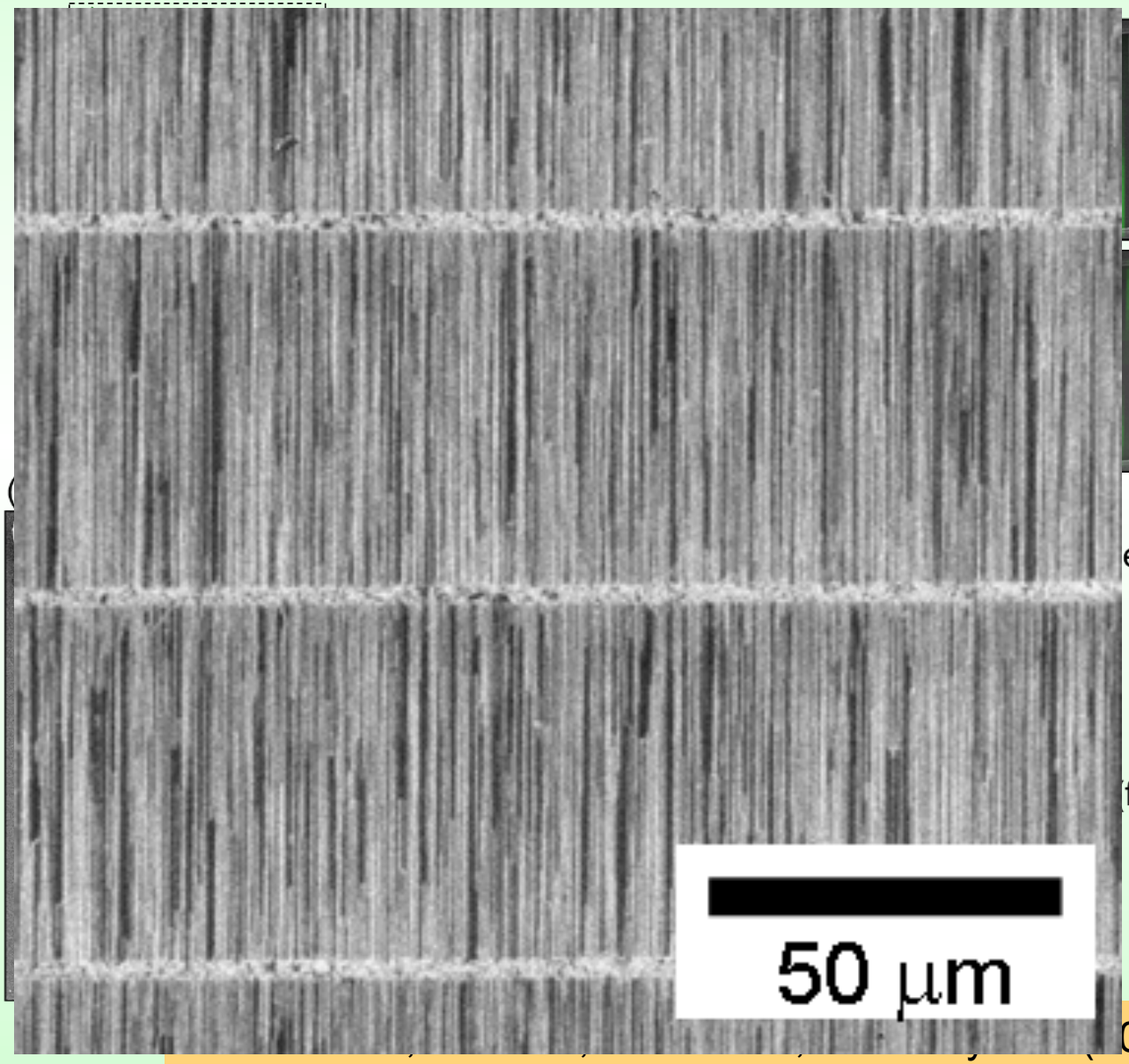


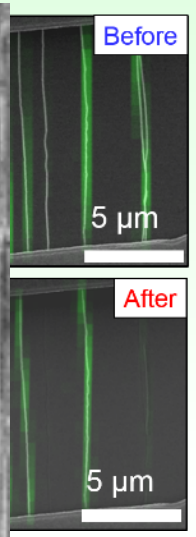
Transparent Conductive Film
(Esko Kauppinen, Canatu@Finland)

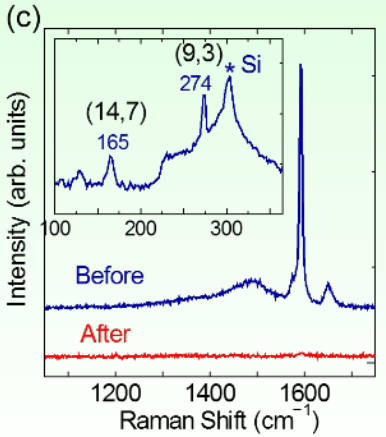


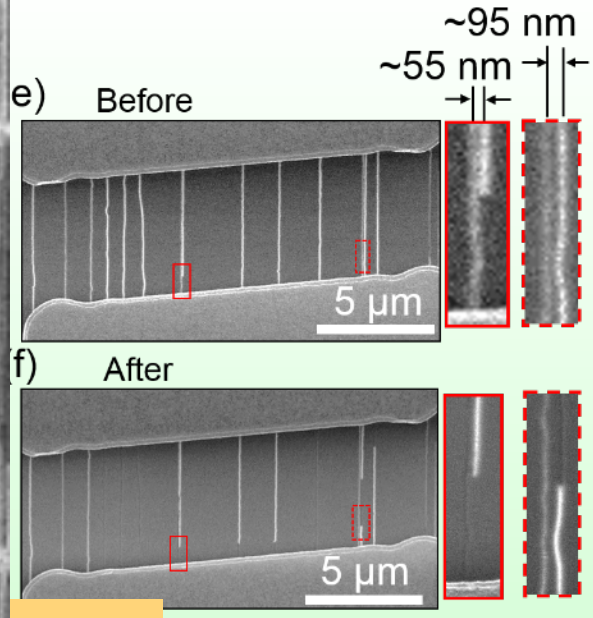


Full Length Breakdown of Metallic Nanotubes



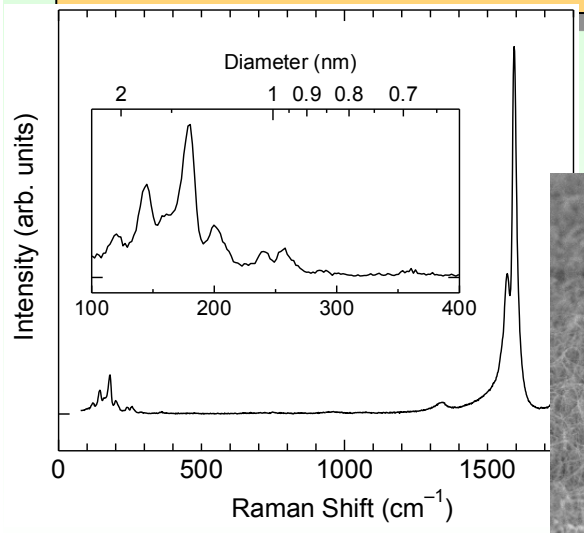


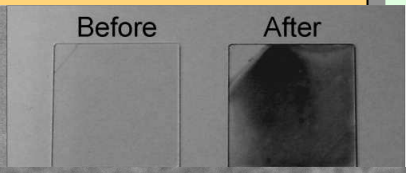


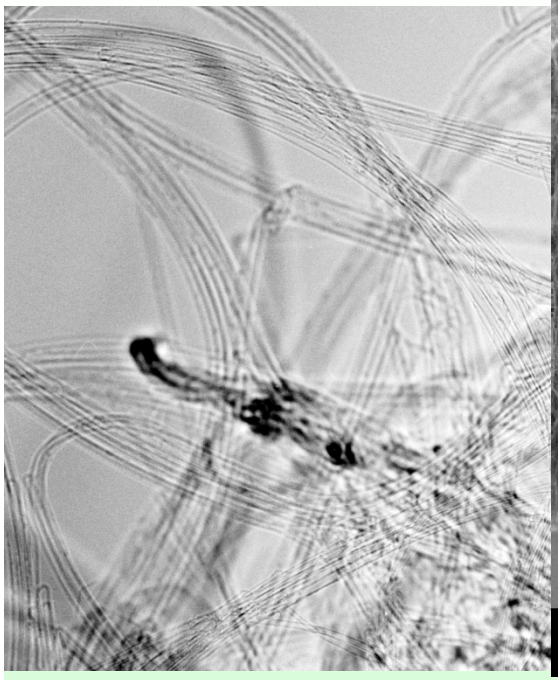


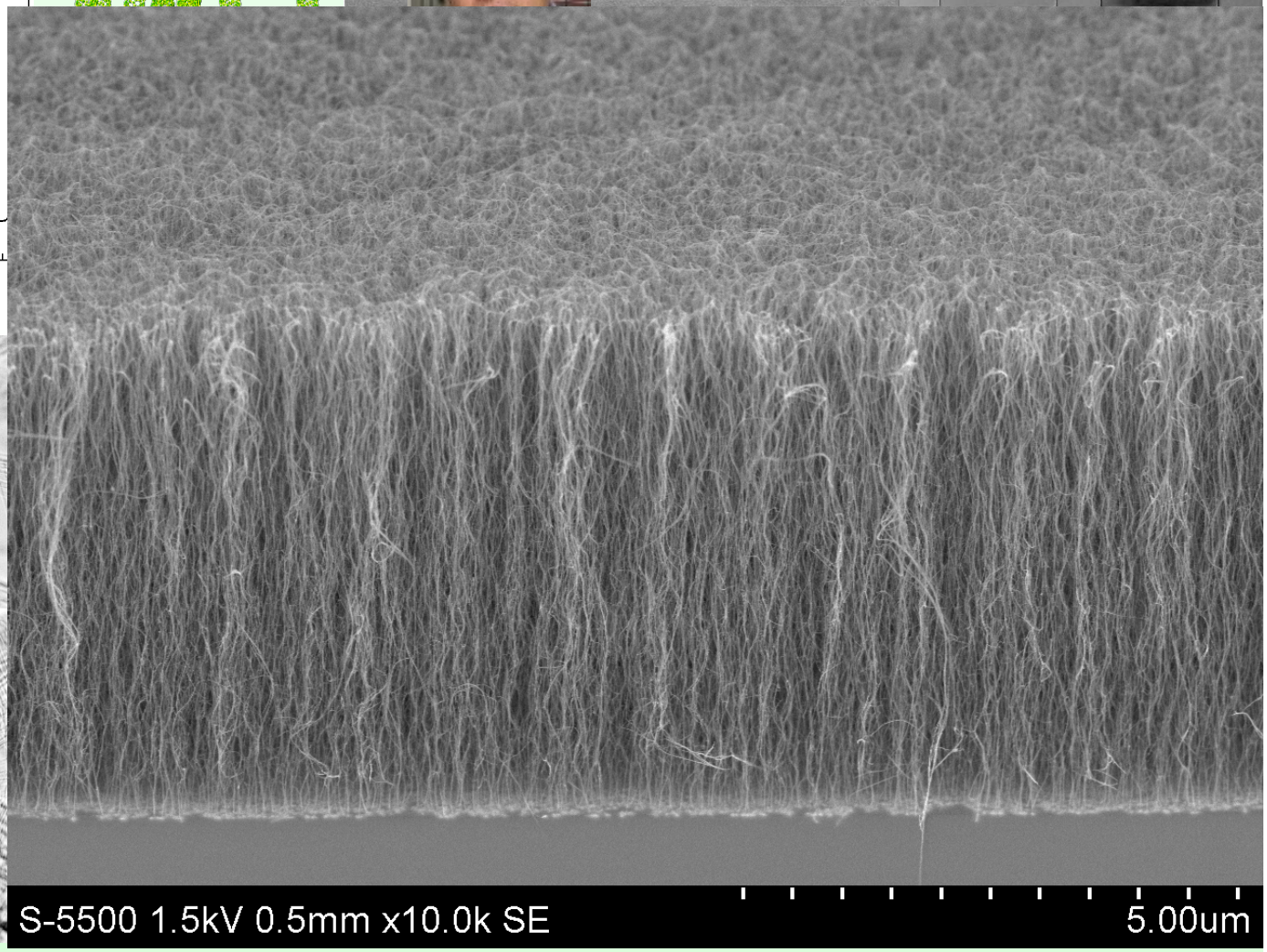
014)

Vertically Aligned SWNTs on Quartz Substrate



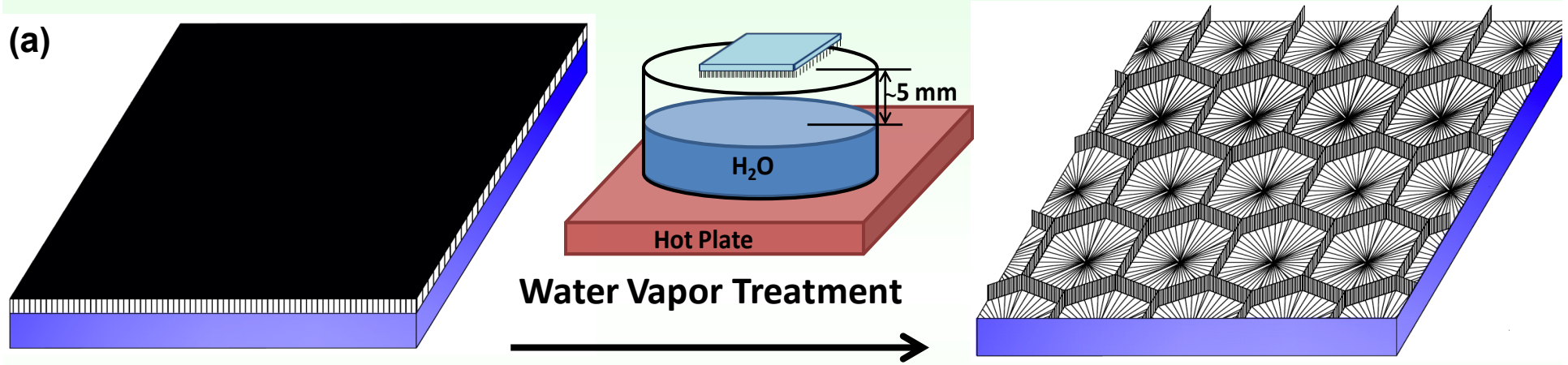


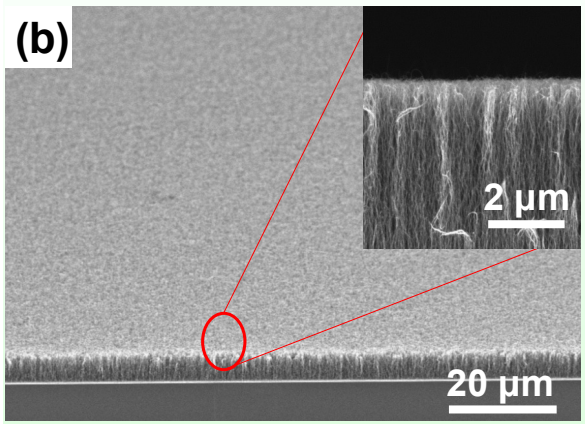


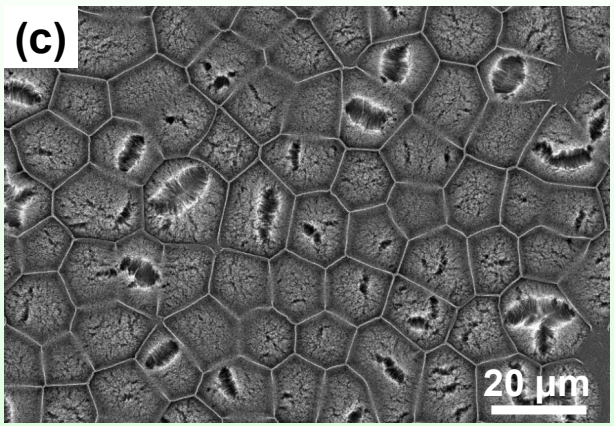


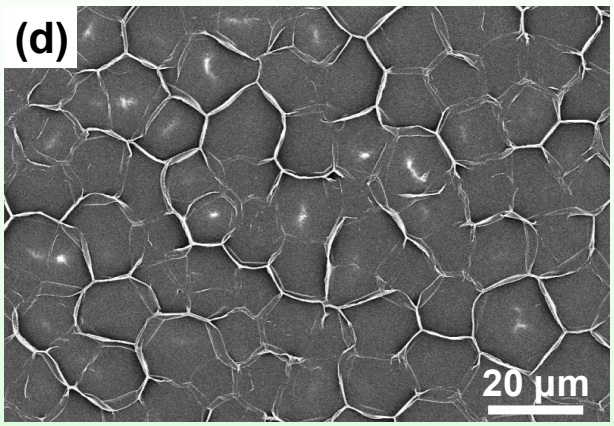
Y. Murakami, S. Chiashi, Y. Miyauchi, M. Hu, M. Ogura, T. Okubo, S. Maruyama, Chem. Phys. Lett. 385 (2004) 298

Self-organized Honeycomb Structure

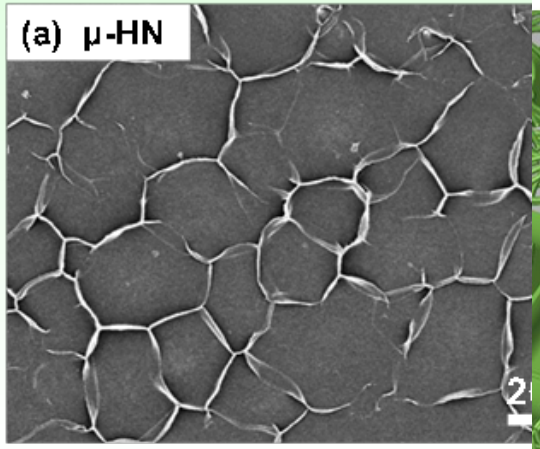




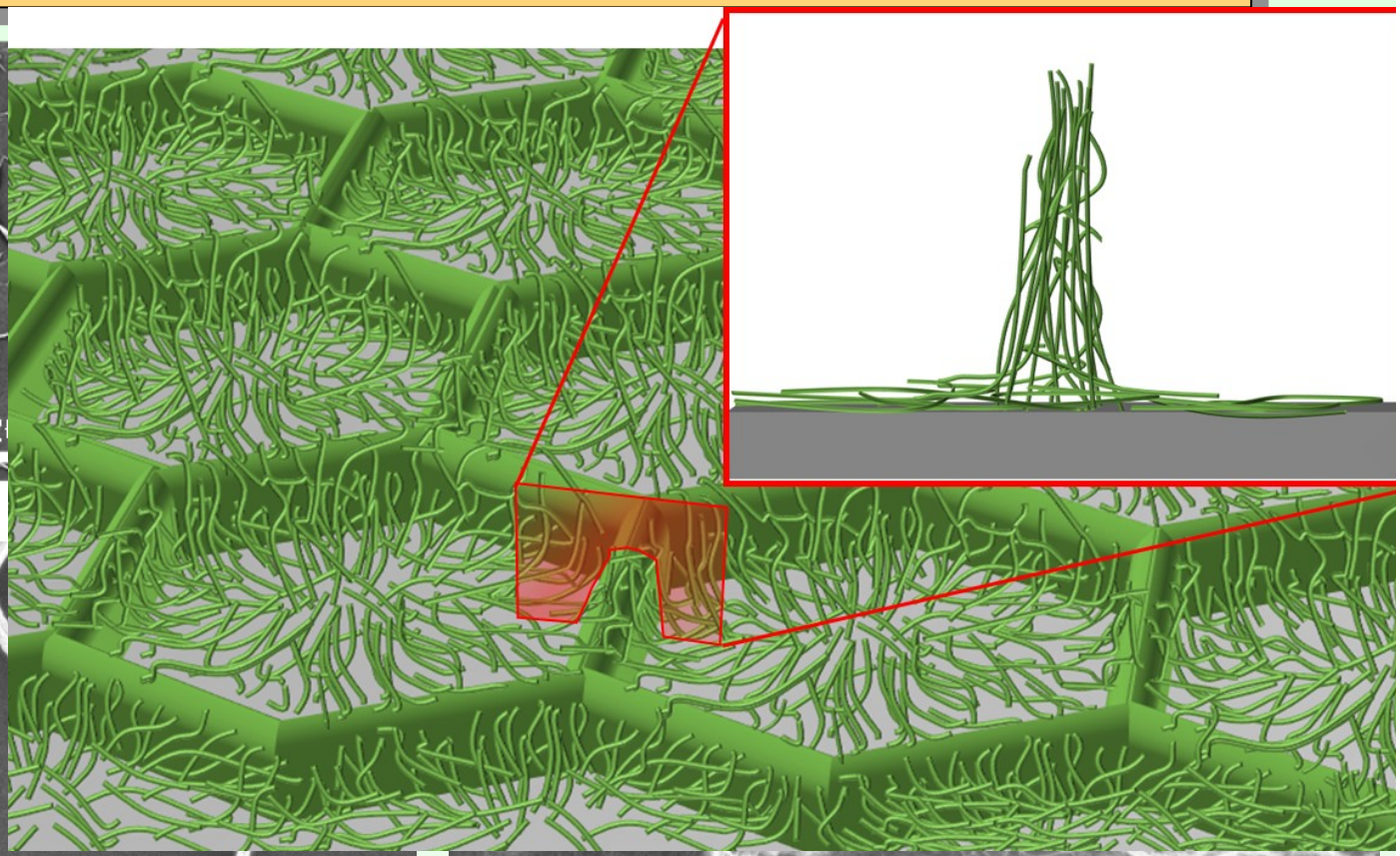


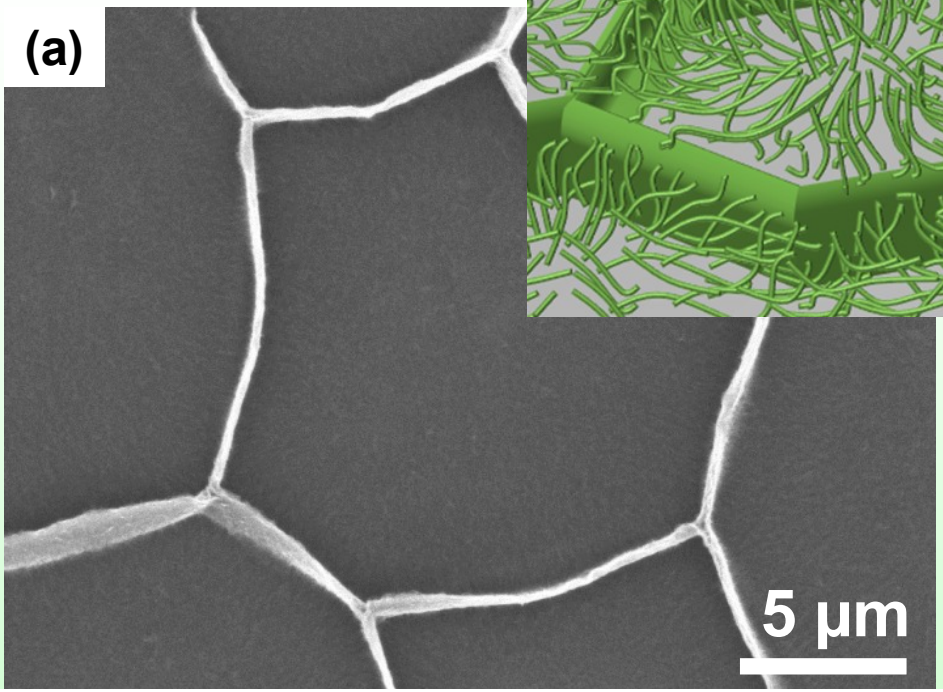


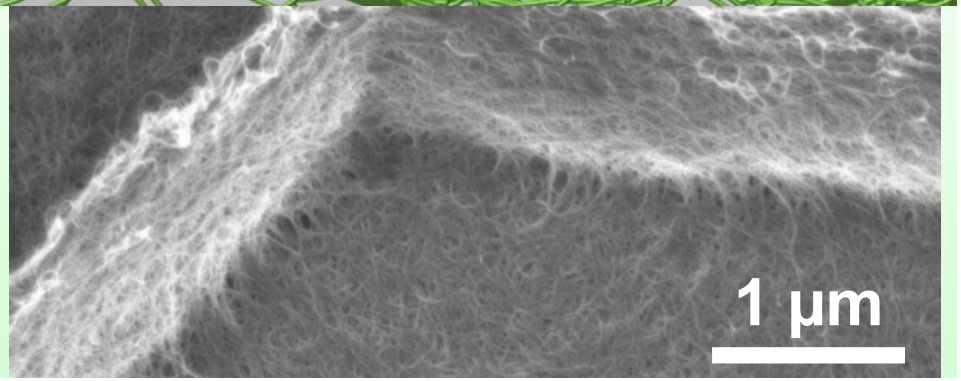
Self-Assembled Micro-Honeycomb



5 s, 80 ˚C



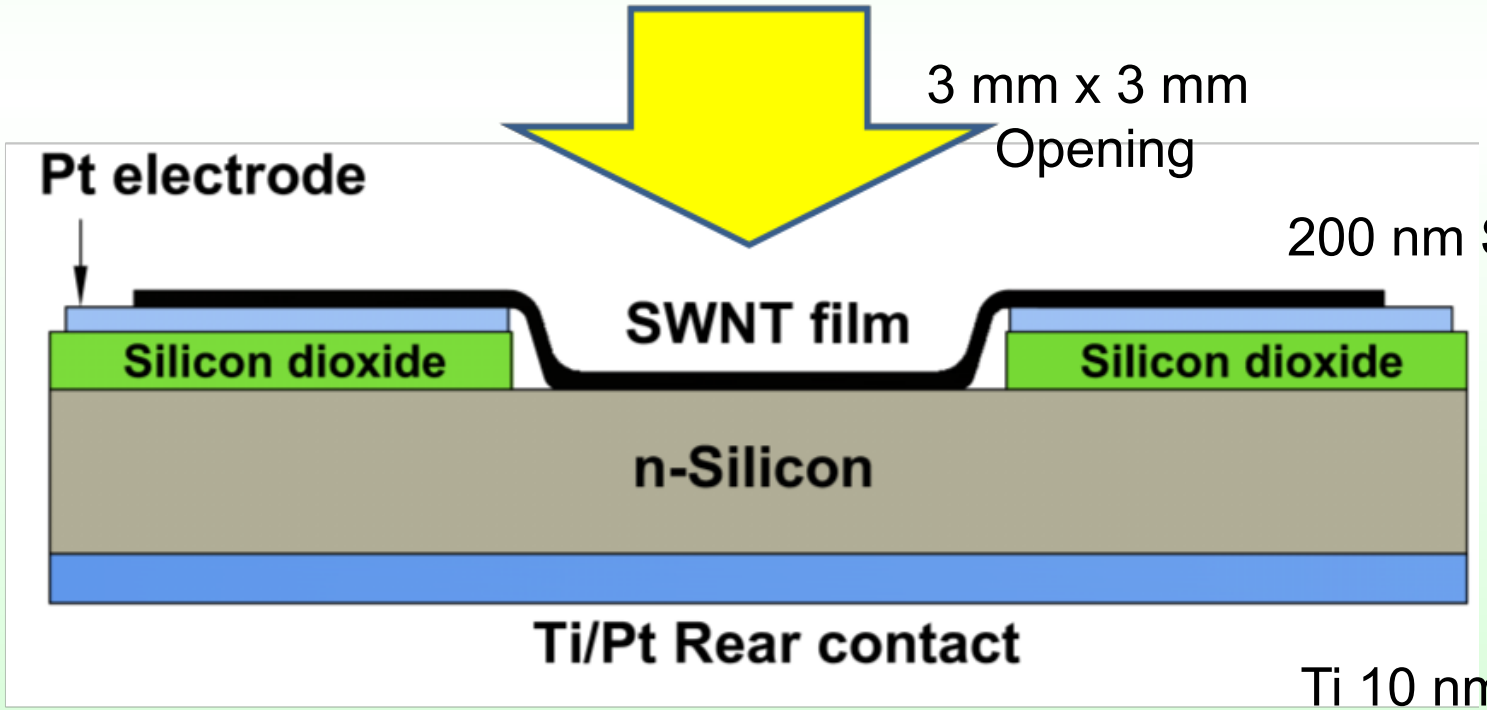




Heterojuction Solar Cell

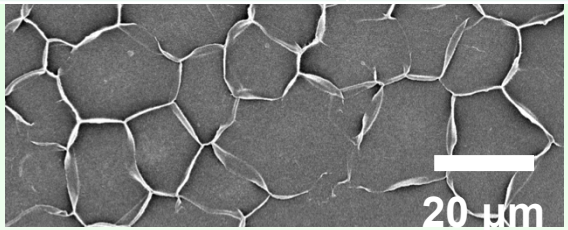
n-type Si (7.5-12.5 Ωcm, ~10^{15} cm^{-3})
With 100 nm SiO_2
5 M NaOH at 90 ˚C for 30min
RCA 2 Cleaning

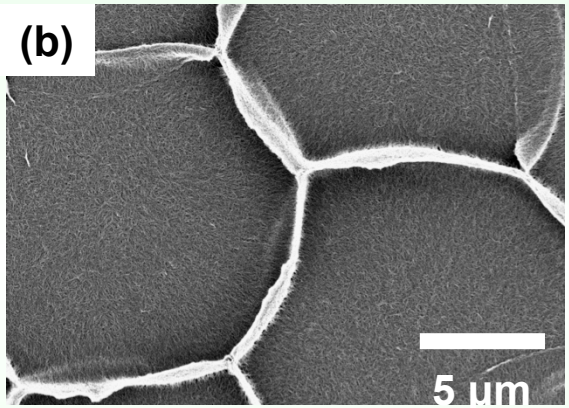
100mW/cm² AM1.5G illumination

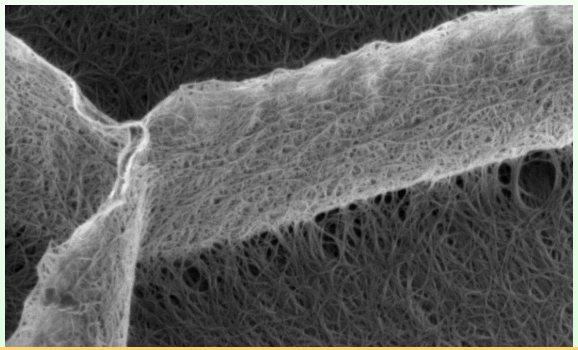


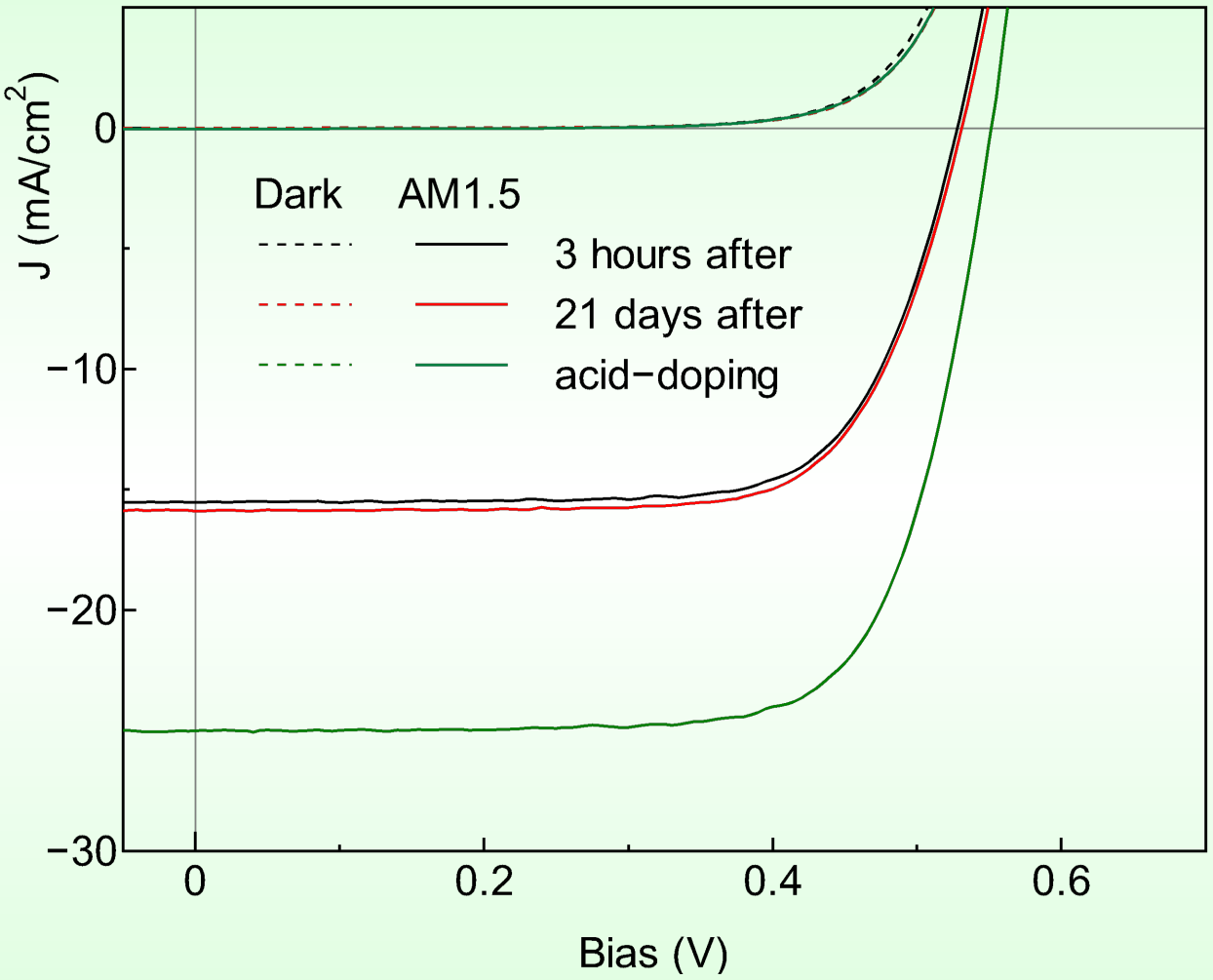
	PCE %	FF %	Jsc	Voc
Pristine 21 days	6.04	72	15.90	0.53
Acid dope 1 hour	10.02	73	25.01	0.55

Solar Cell



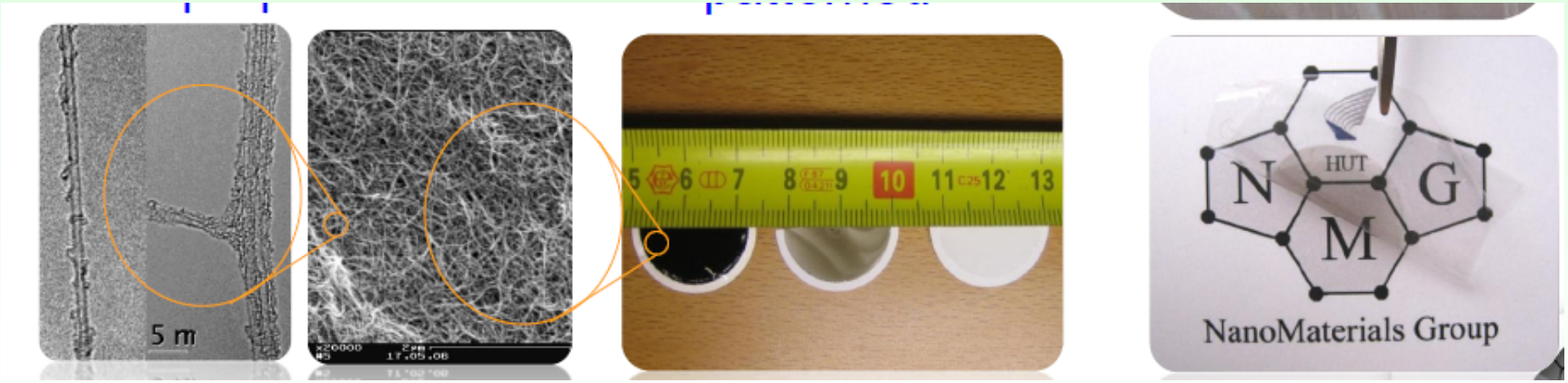






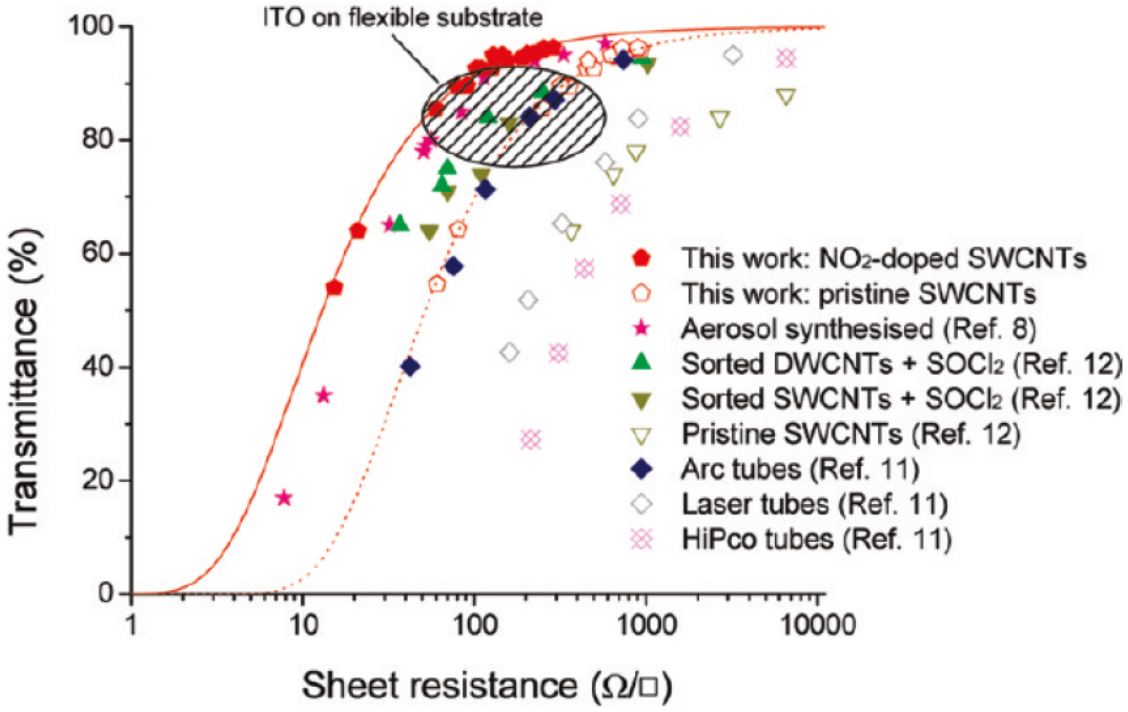
K. Cui, T. Chiba, S. Omiya, T. Thurakitseree, P. Zhao, S. Fujii, H. Kataura, E. Einarsson, S. Chiashi, S. Maruyama, *J. Phys. Chem. Lett.*, 4 (2013) 2571.

Transparent Conductive Film by Esko Kauppinen

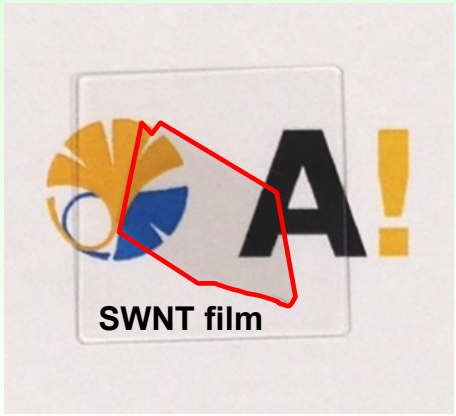


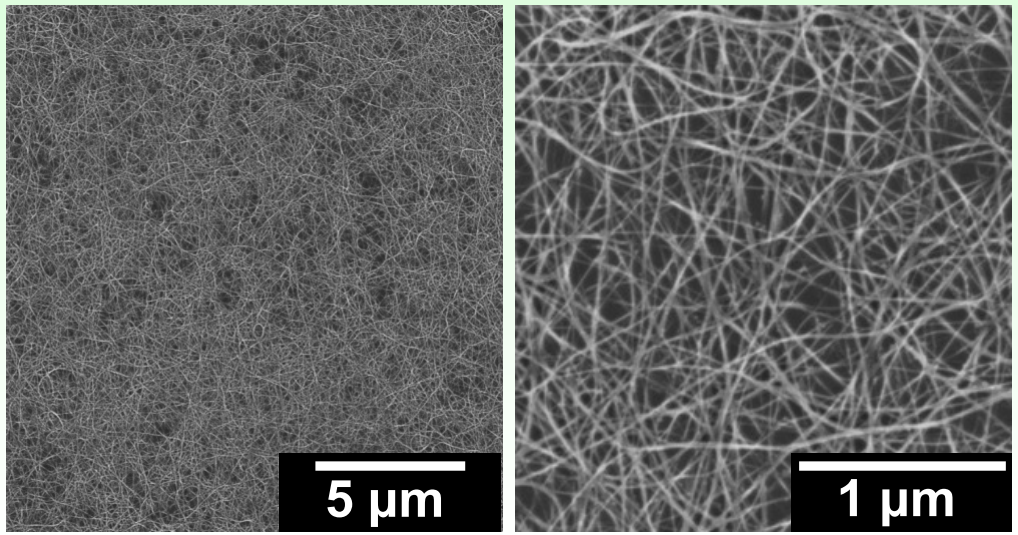
State of the art :
84 Ω/sq. @ 90%
Kauppinen Group
at Aalto Univ.

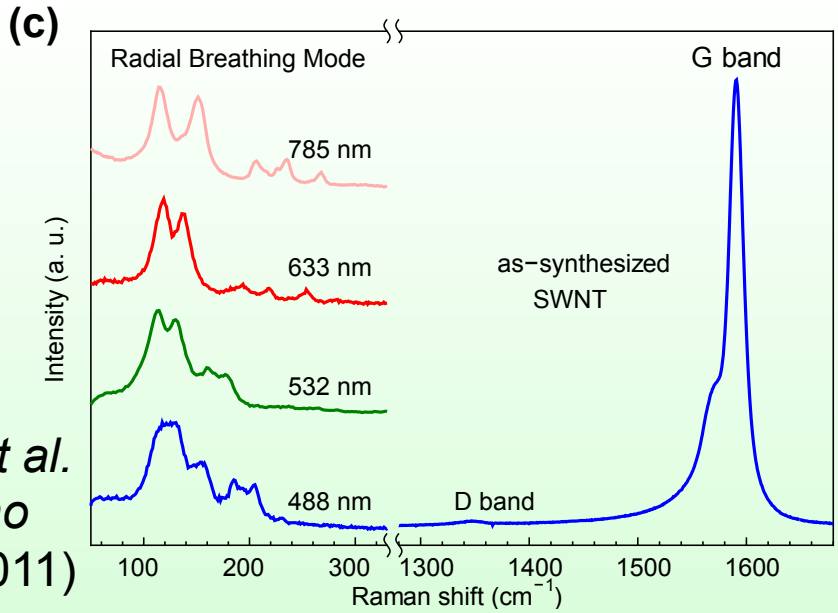
Nasibulin et al.
ACS Nano
5, 3214 (2011)

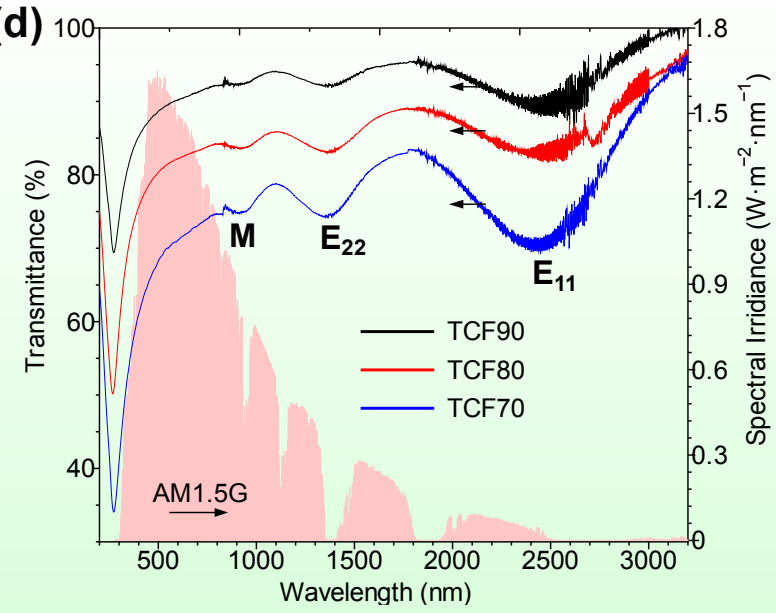


Transparent Conductive Film by Aerogel CVD





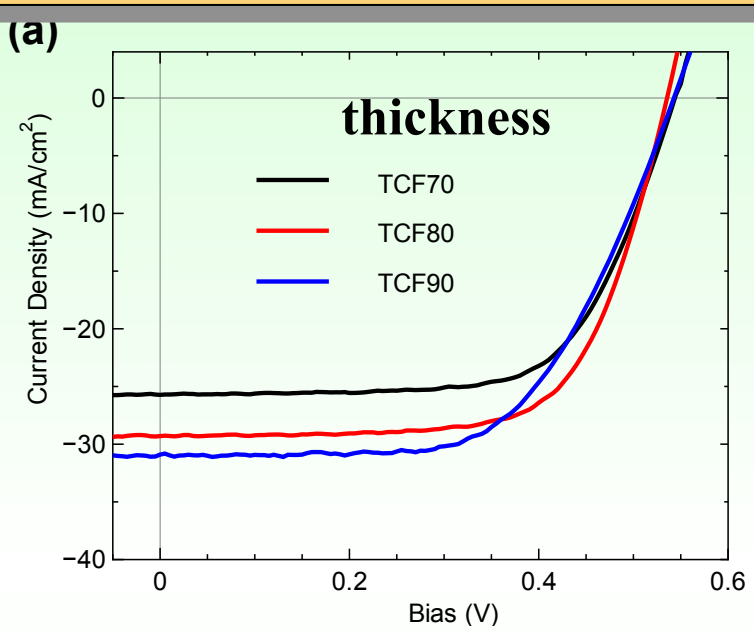


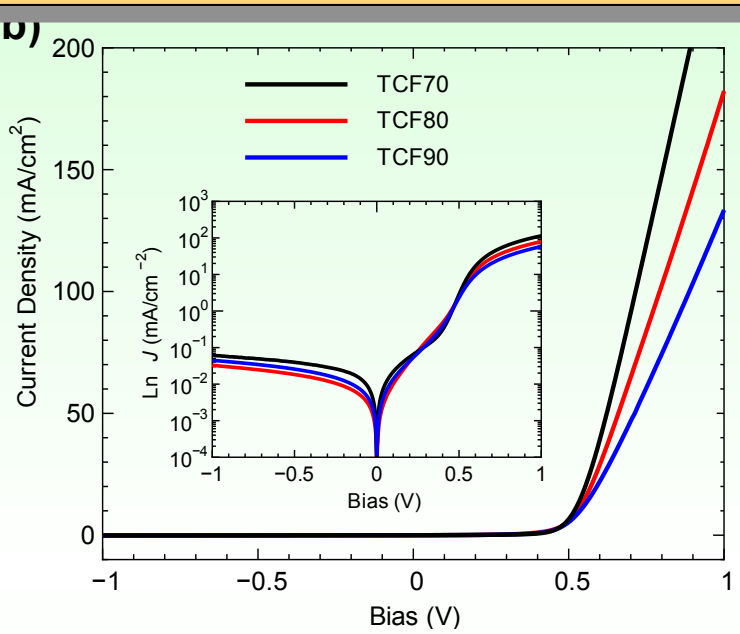


Nasibulin et al.
ACS Nano
5, 3214 (2011)

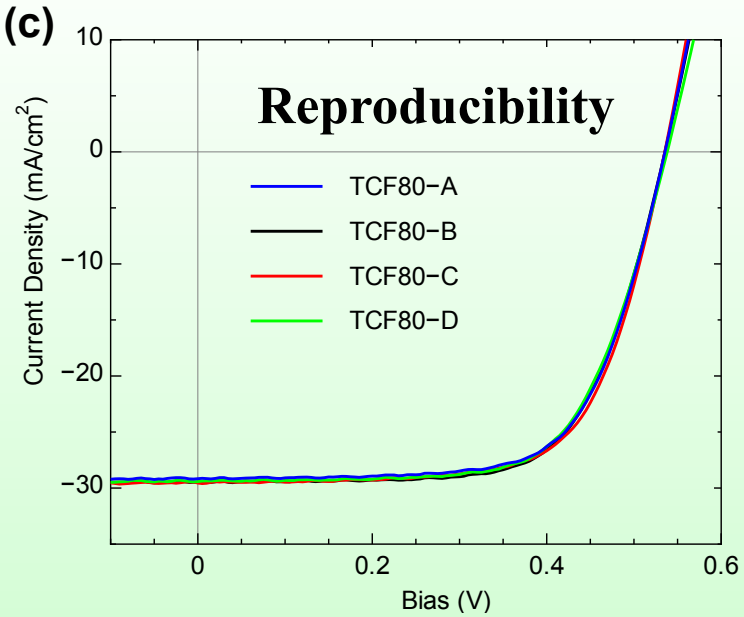
Collaboration with Olivier Reynaud, Albert Nasibullin, Esko I. Kauppinen (Aalto Univ.)

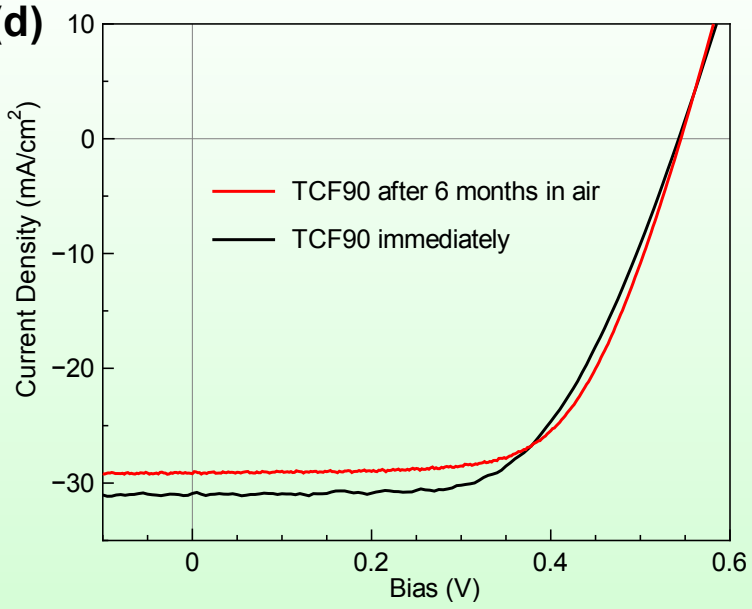
Transparent Conductive Film by Aerogel CVD





dark condition



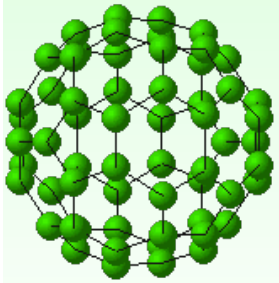


stability

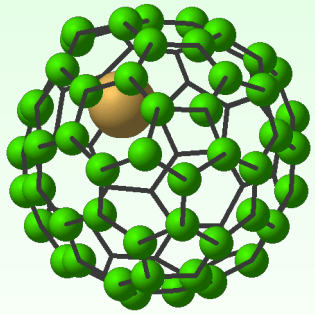
FNTG Research Society

FNTG Research Society

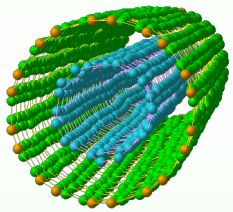
http://fullerene-jp.org/



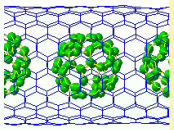
Fullerene



Metallofullerene



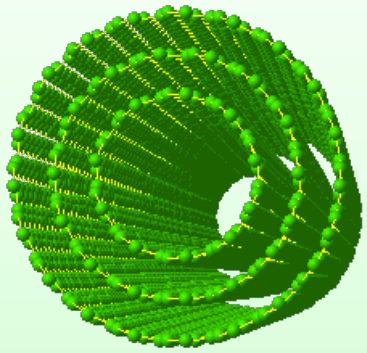
Double-Walled
Carbon Nanotubes



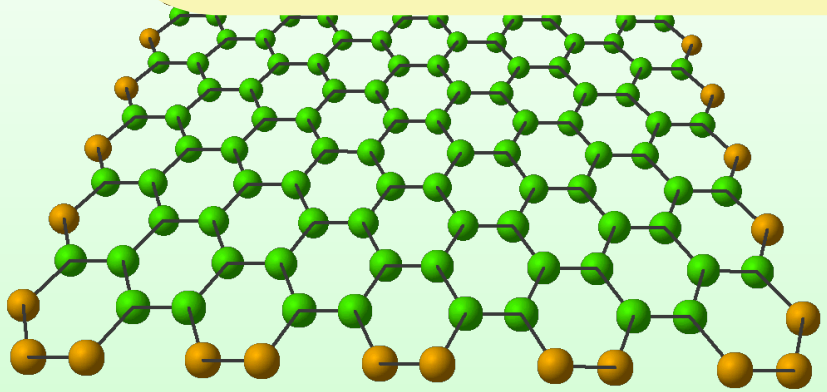
Peapo

Meetings

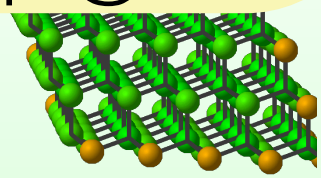
2014/3/3-5: FNTG 46 Symp. @ Tokyo
2014/6/2-6: *NT14 @ Los Angeles*
2014/9/3-5: FNTG 47 Symp. @ Nagoya
2015/3/??: FNTG 48 Symp. @ Tokyo
2015/6/28-7/4: *NT15 @ Nagoya*
2015/9/??: FNTG 49 Symp. @ Fukuoka
2015/12/15-20: *Pacifichem @ Honolulu*
2016/3/??: FNTG 50 Symp. @ Tokyo
2016/9/??: FNTG 51 Symp. @ ???



Multi-Walled
Carbon Nanotubes



Graphene



Nano-Diamond