奈米世界之美

http://www.botanik.uni-bonn.de/system/lotus/en/lotus_effect_html.html

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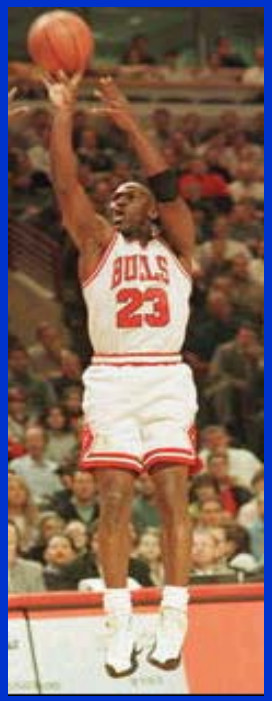
中研院物理所研究員

什麼是奈米(nano-meter) = ?

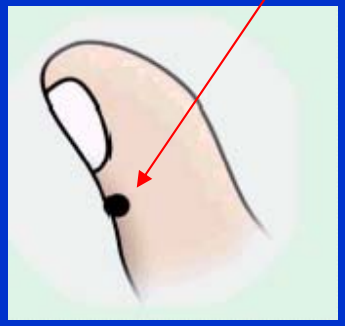
1 米 = 1 m



人高

1 釐米（公分） = $1x10^{-2}$ m

1 毫米 = $1x10^{-3}$ m



指頭

1 微米 = $1x10^{-6}$ m

紅血球

1 奈米 = $1x10^{-9}$ m

分子及DNA

0.1 奈米

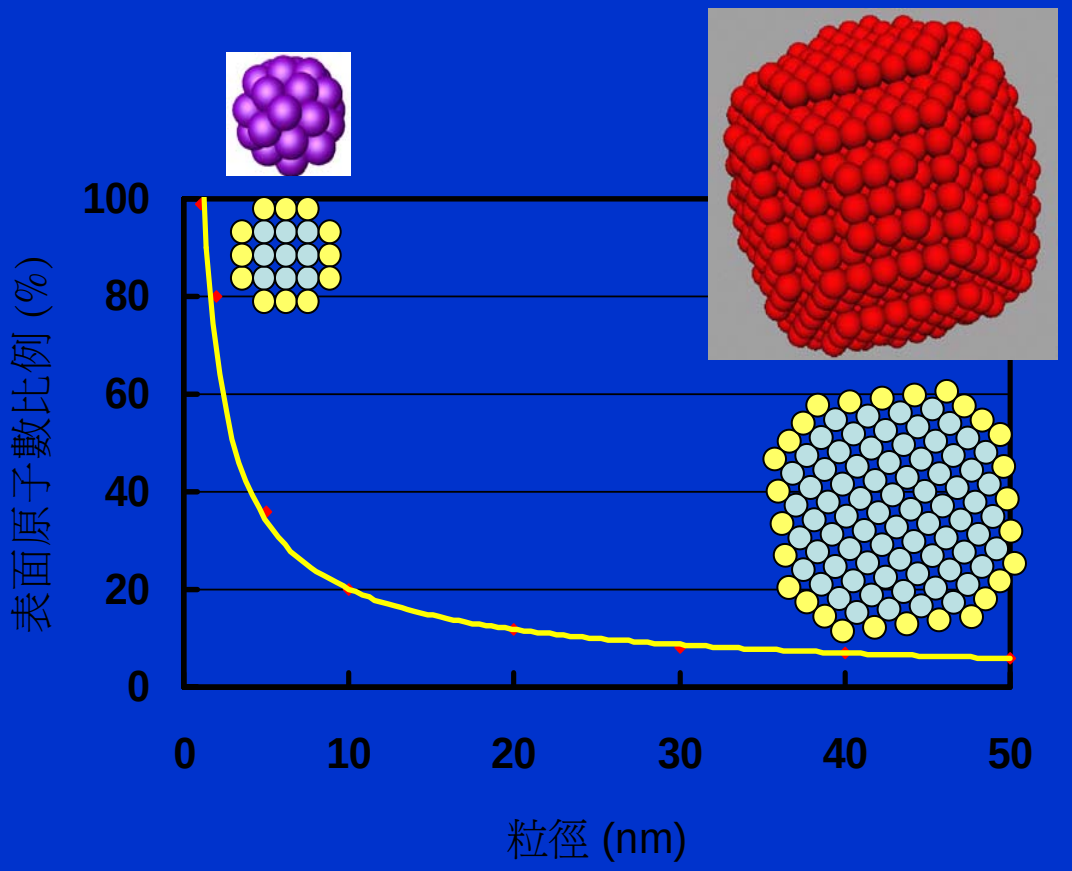
氫原子

奈米下之物理化學性質是否會改變？

1.表面/體積　比例增加

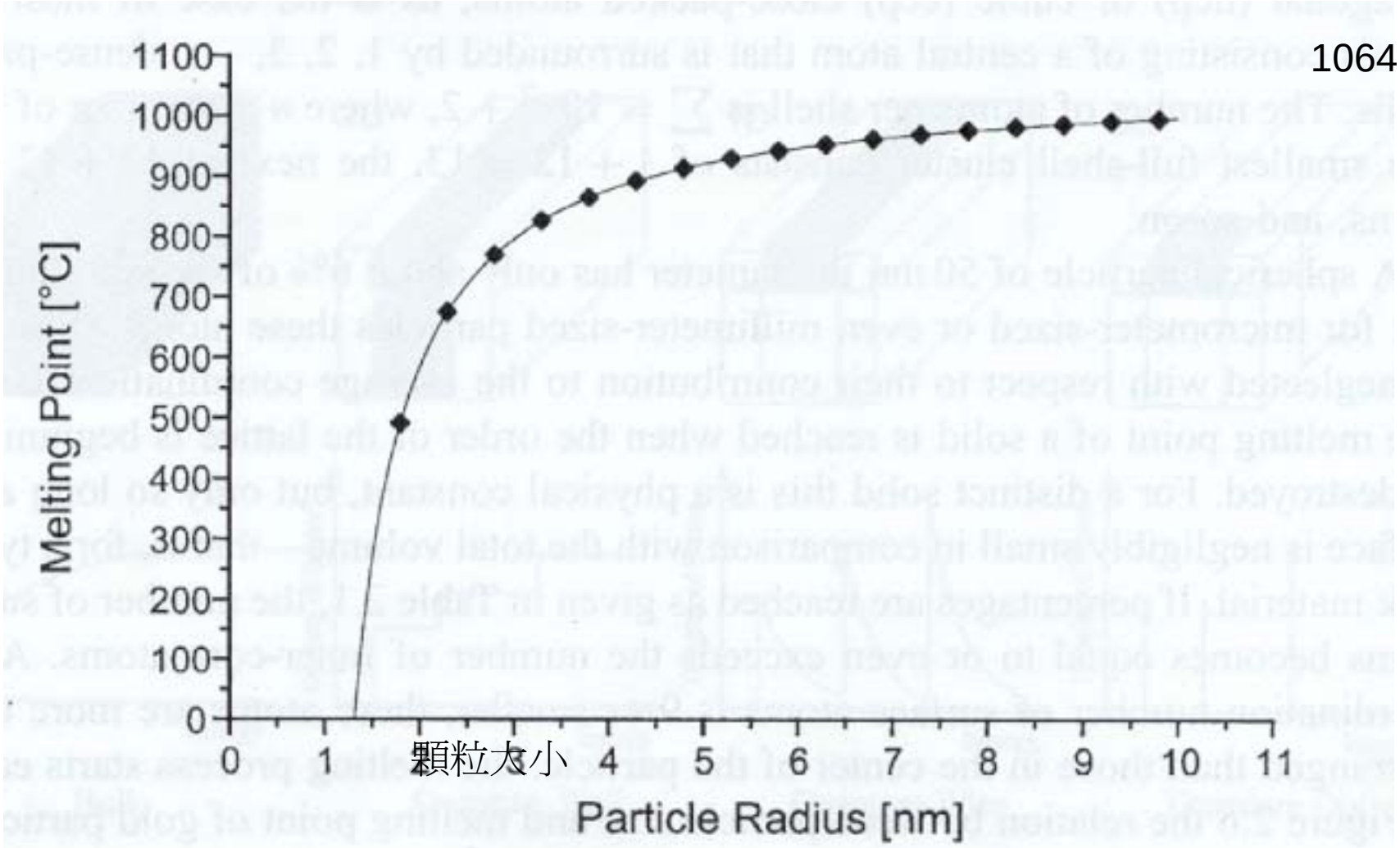
.1 The relation between the total number of atoms i
ters and the percentage of surface atoms

Clusters	Total Number of Atoms	Surface A (%)
	13	92
	55	76
	147	63
	309	52
	561	45
	1415	35

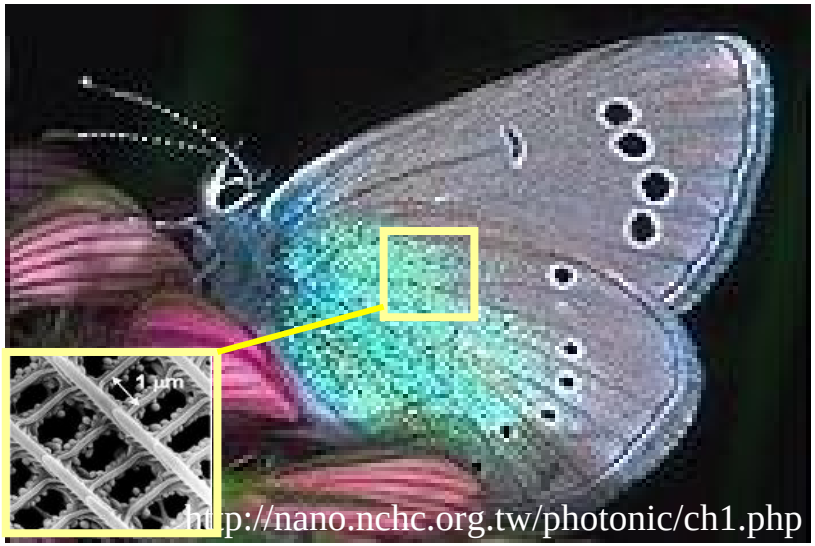


2. 熔點變小

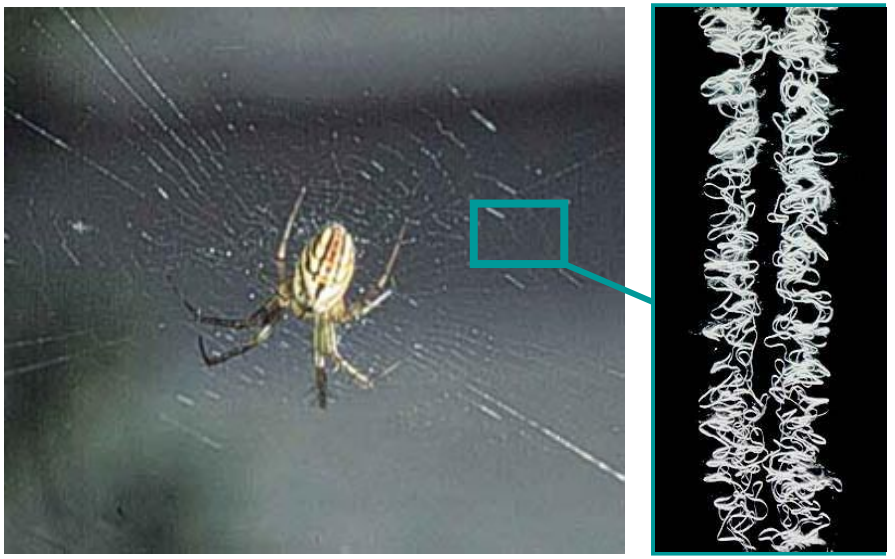
金的熔點與顆粒大小的關係



自然界存在的現象



http://nano.nchc.org.tw/photonic/ch1.php



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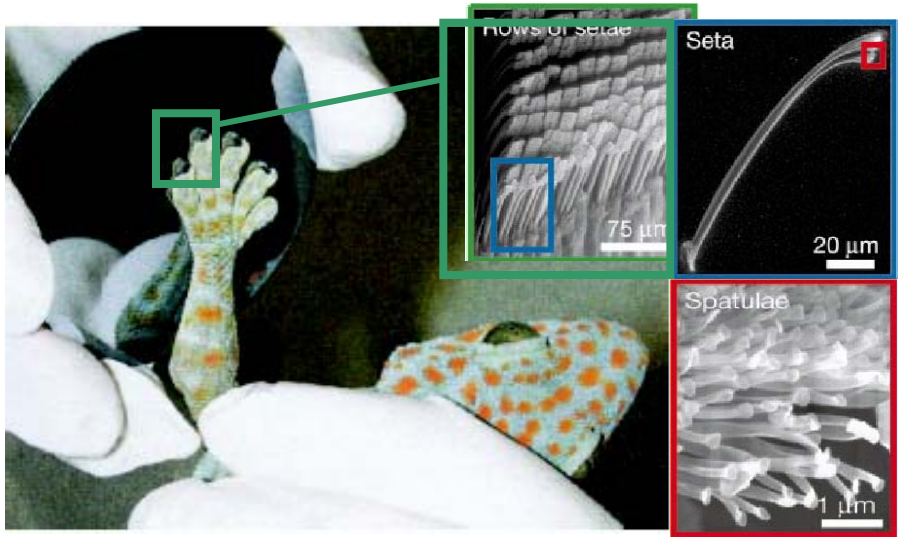
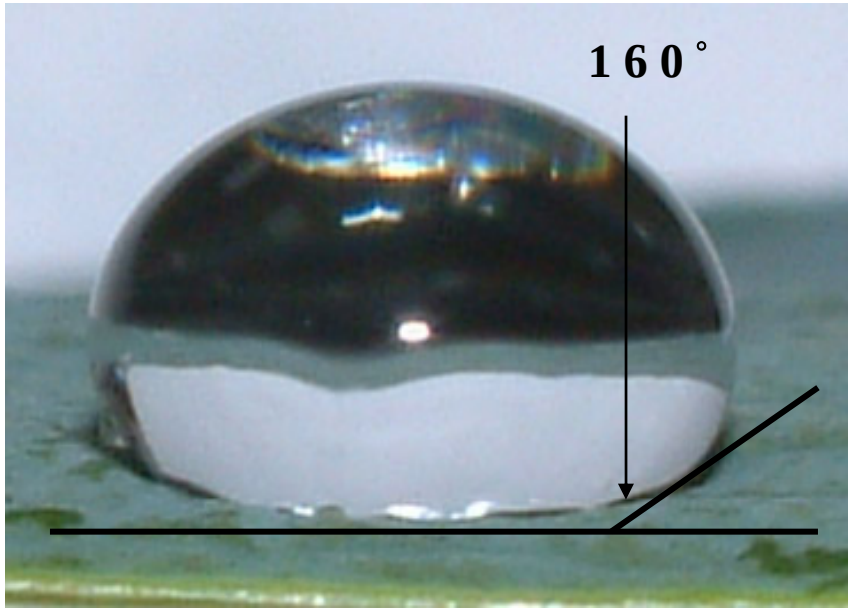
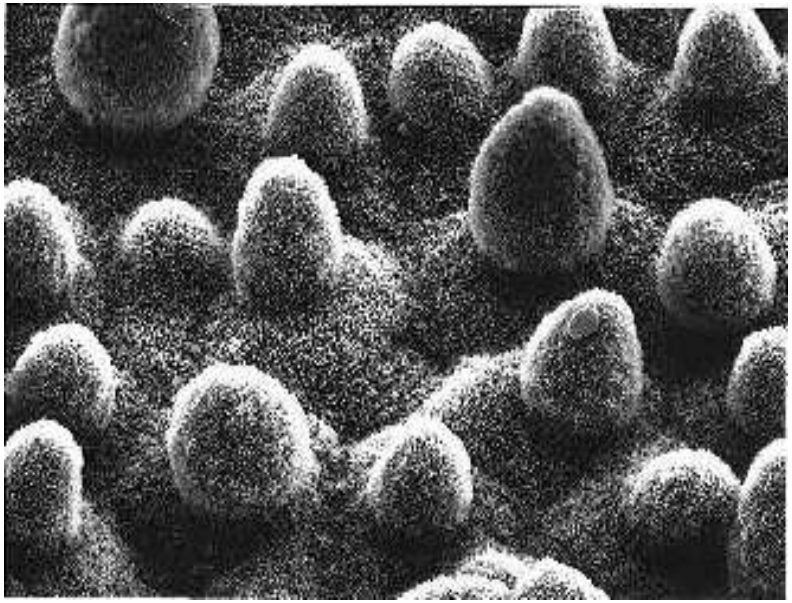
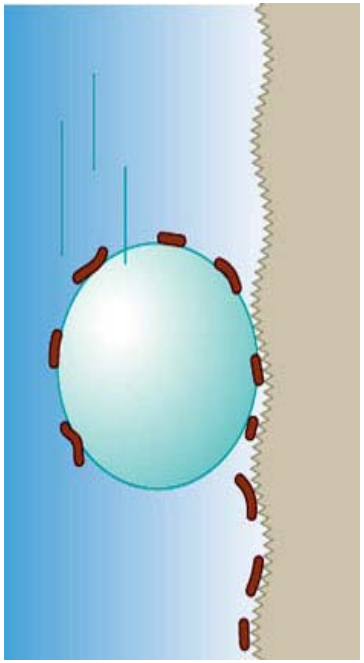
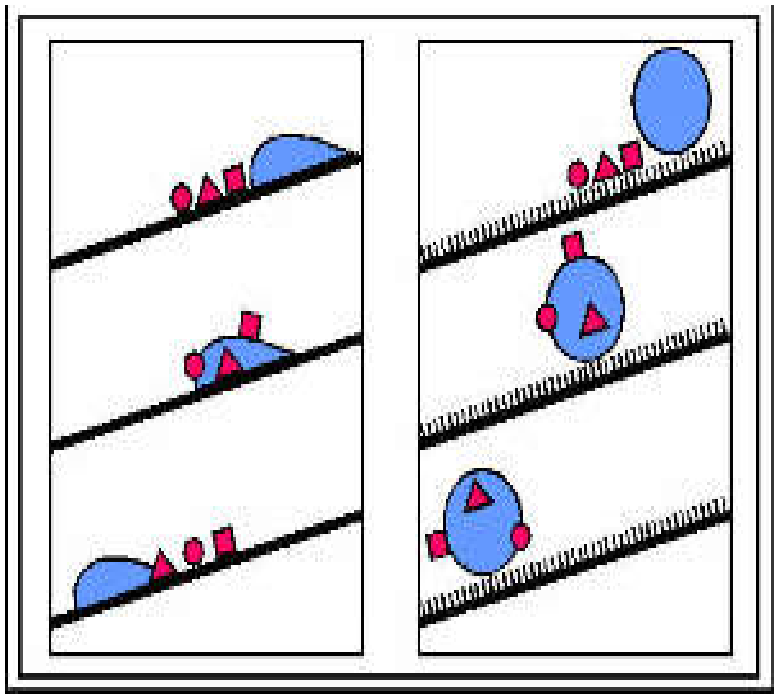


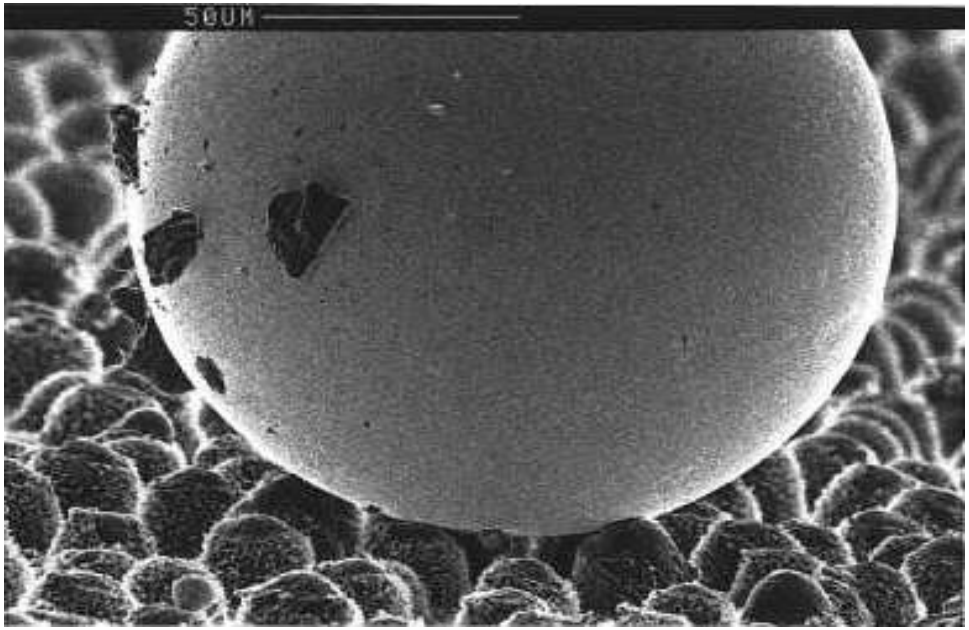


蓮花效應



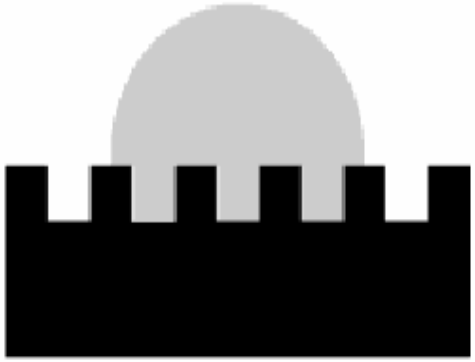




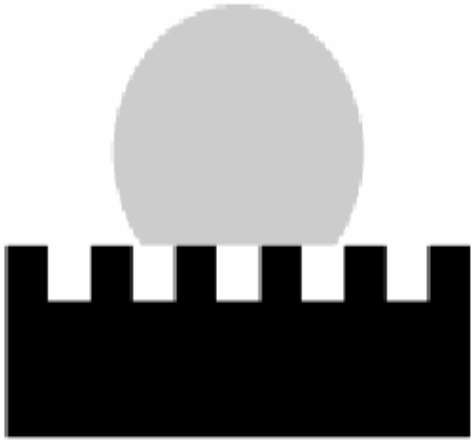

50UM

Theoretical Models

Model Surface



(a) Filled-up grooves
('wetting' contact)

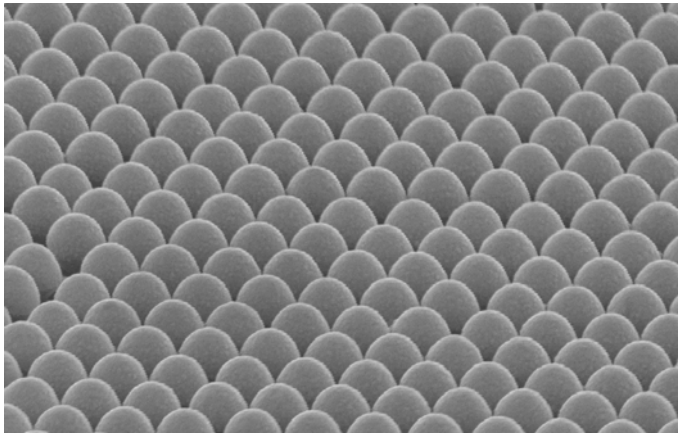


(b) Composite surface

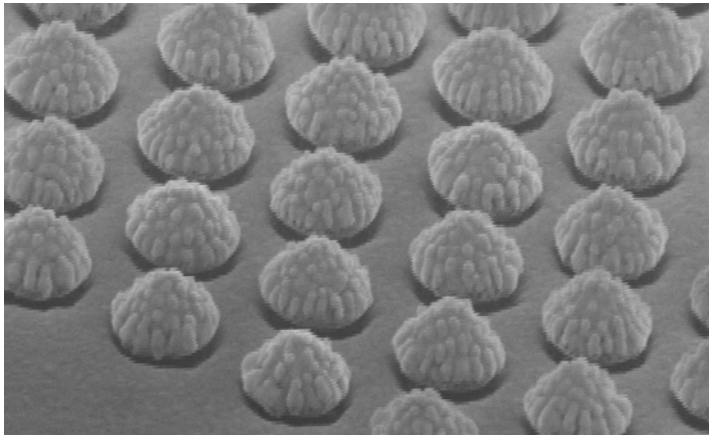
$$\cos\theta^* = A\cos\theta$$

$$\cos\theta^* = -1 + \phi_S(\cos\theta + 1)$$

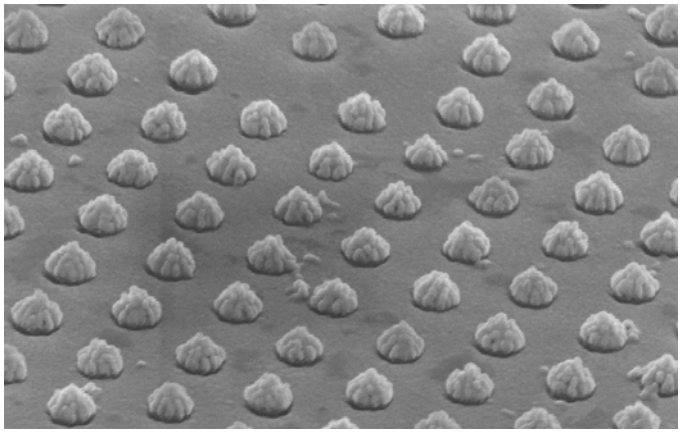
Oxygen Etching of Polystyrene Beads (60^0 View)



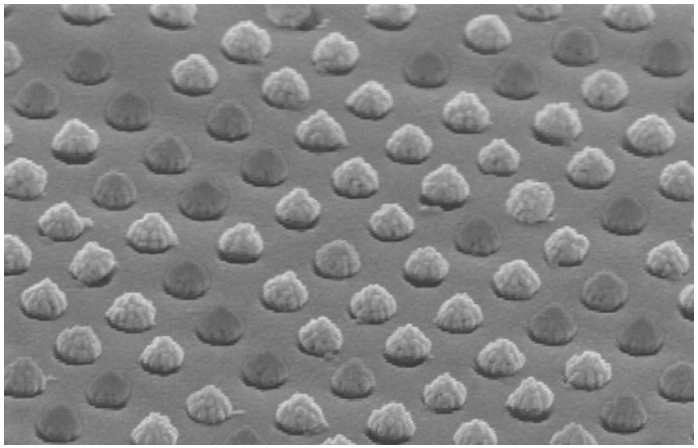
35 S



80 S



100 S

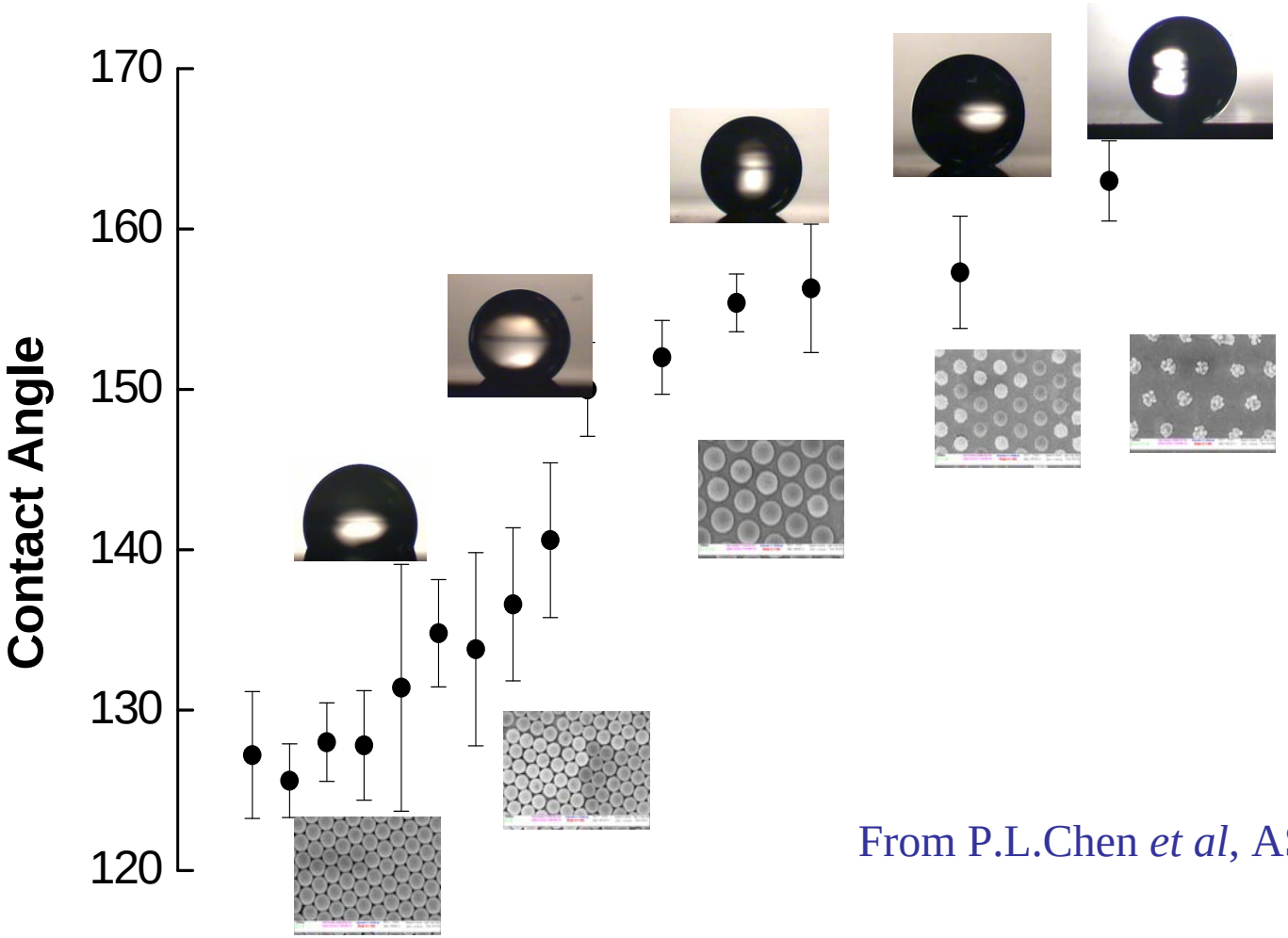


110 S

Chen et al, Chem. Mater. (2004)

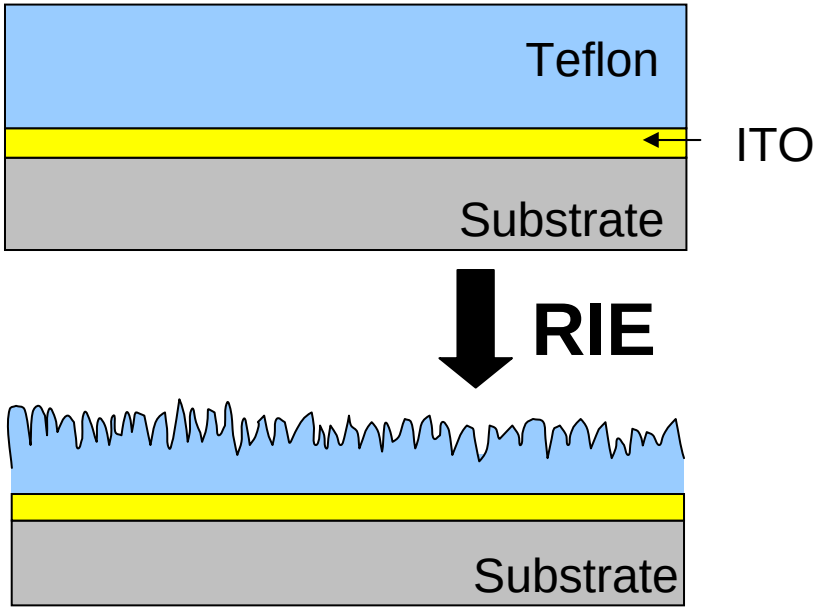
奈米科學與技術的內容

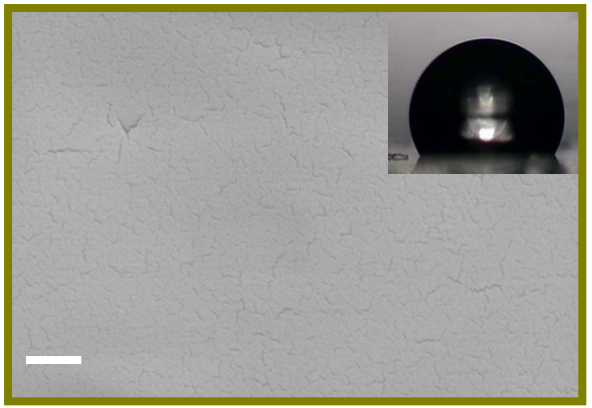
Water Contact Angles on Model Surfaces



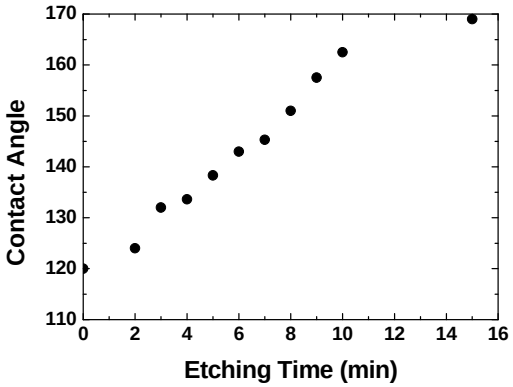
From P.L.Chen *et al*, AS-ASRC (2003)

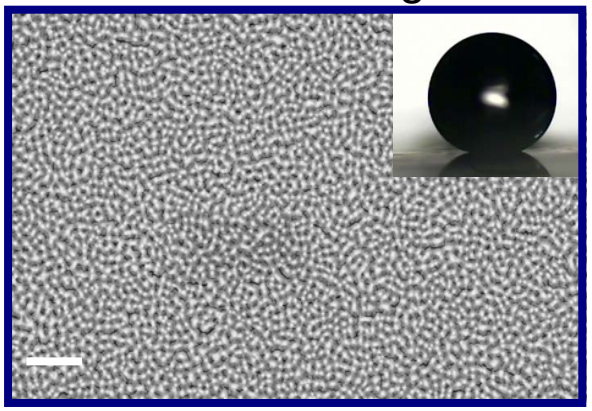
Surface Roughening by Plasma Treatment





Contact Angle 120°

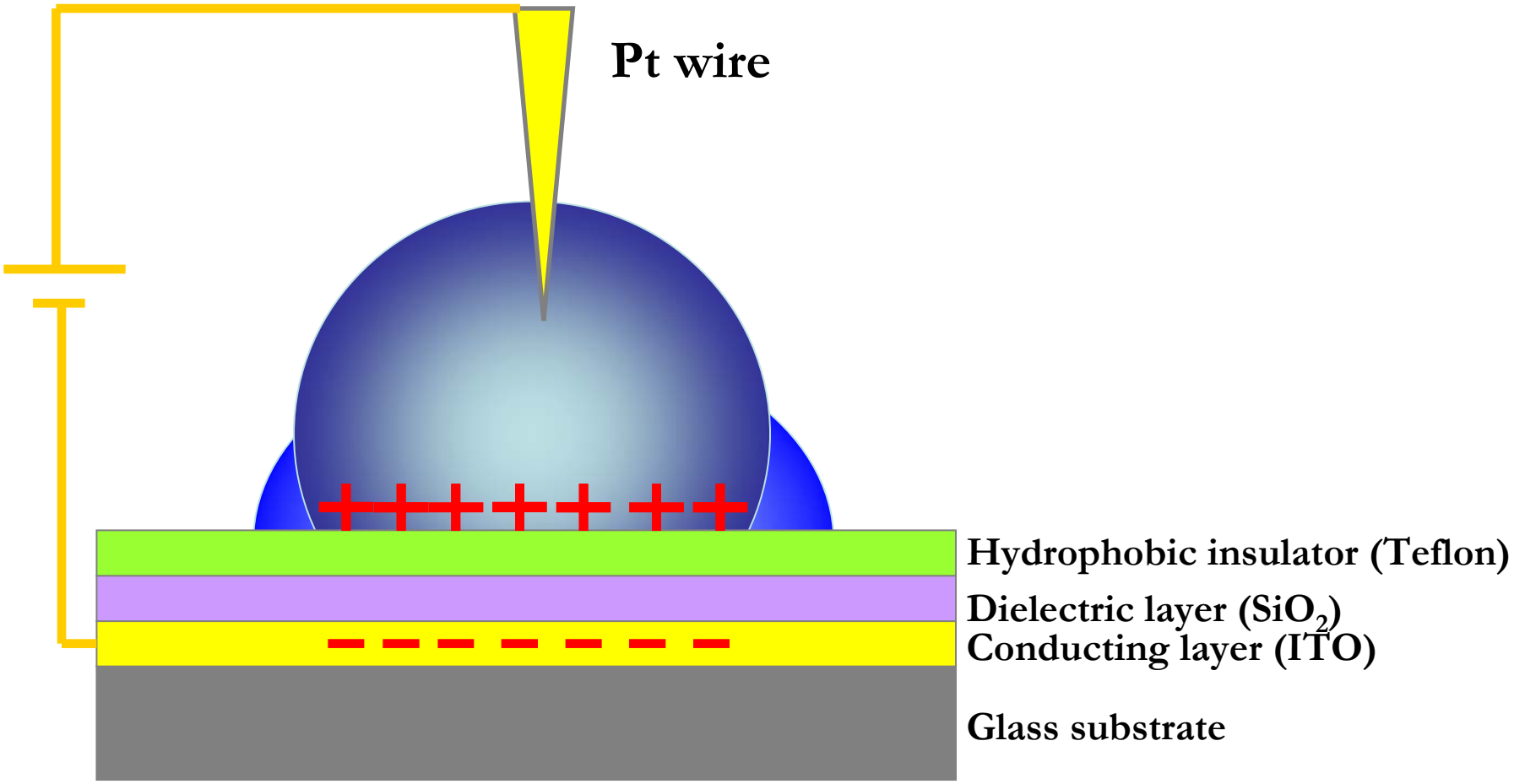




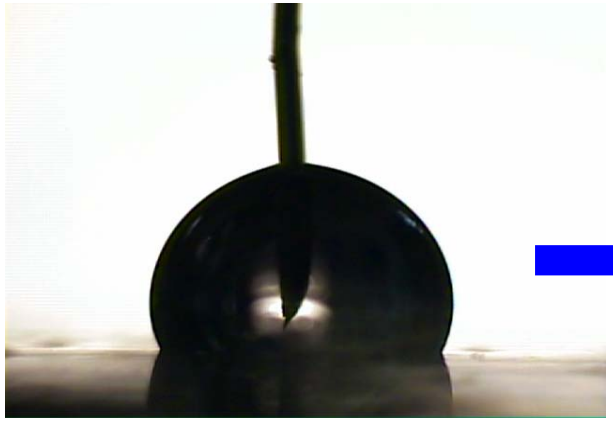
Chen et al, SPIE (2004)

Contact Angle 169°

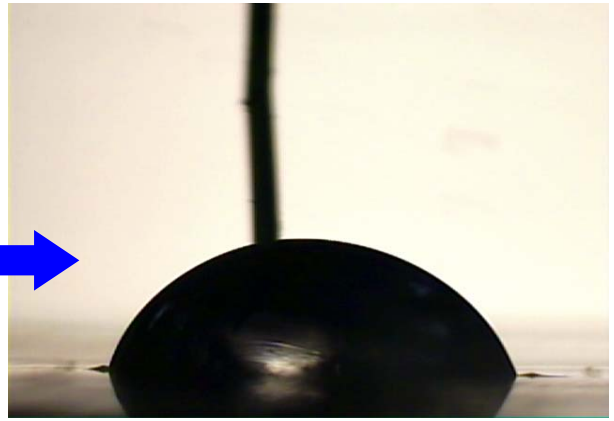
Experimental Section



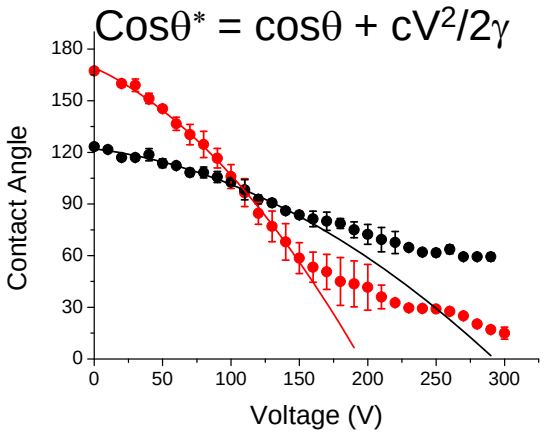
Electrowetting

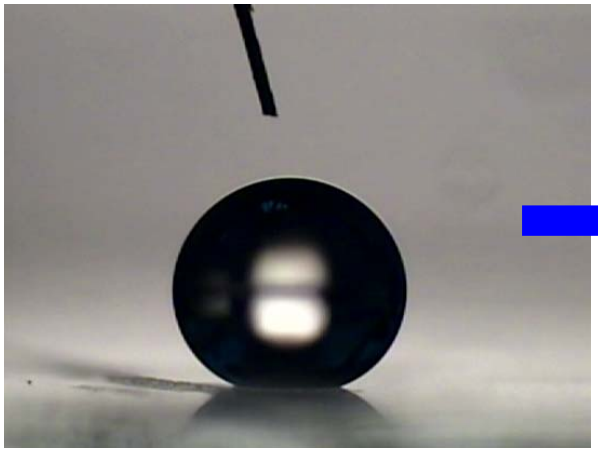


CA114º

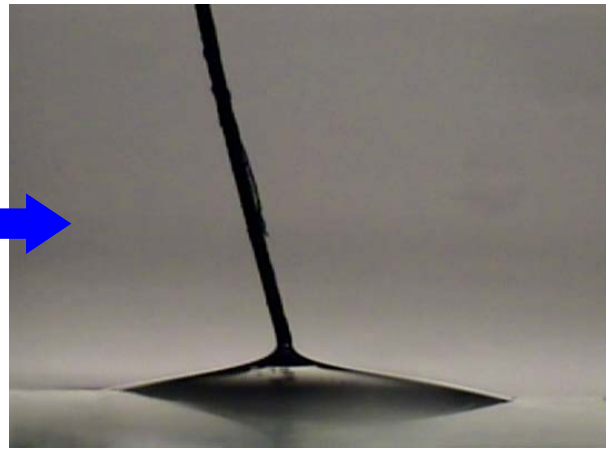


CA67º

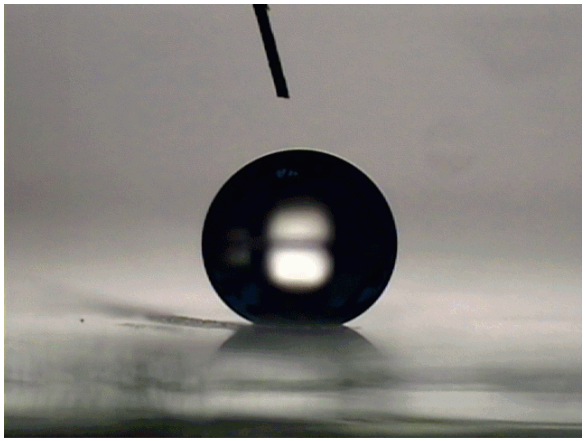




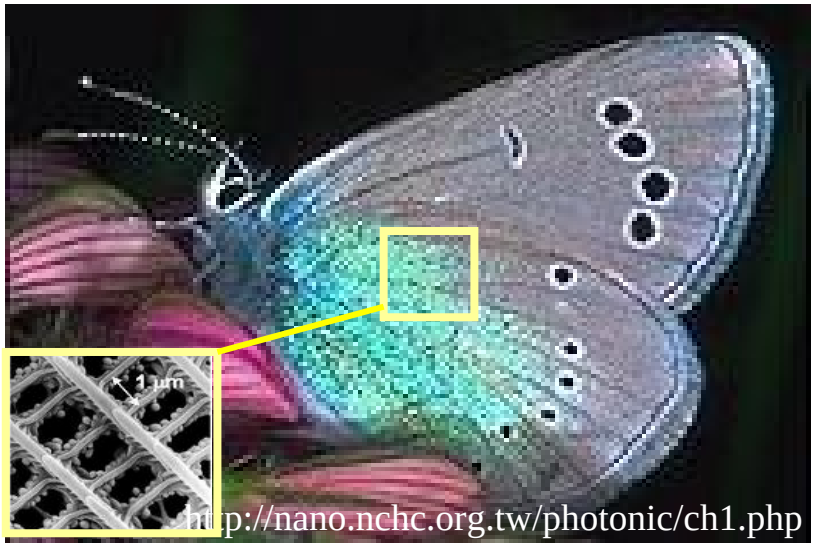
CA168º



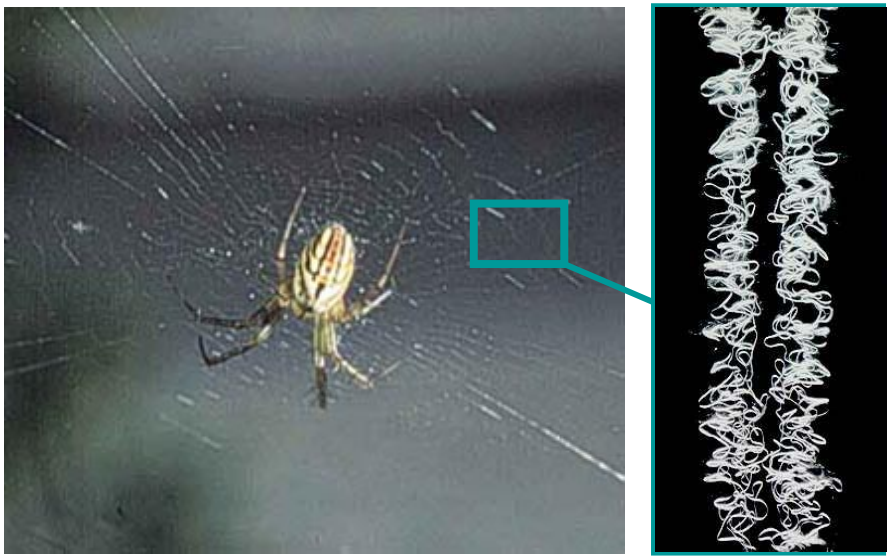
CA11º



自然界存在的現象



http://nano.nchc.org.tw/photonic/ch1.php



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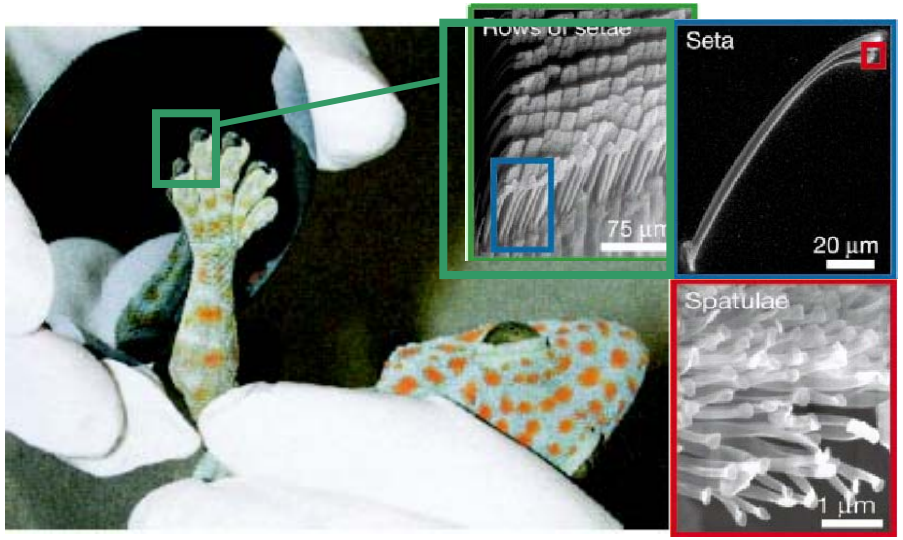
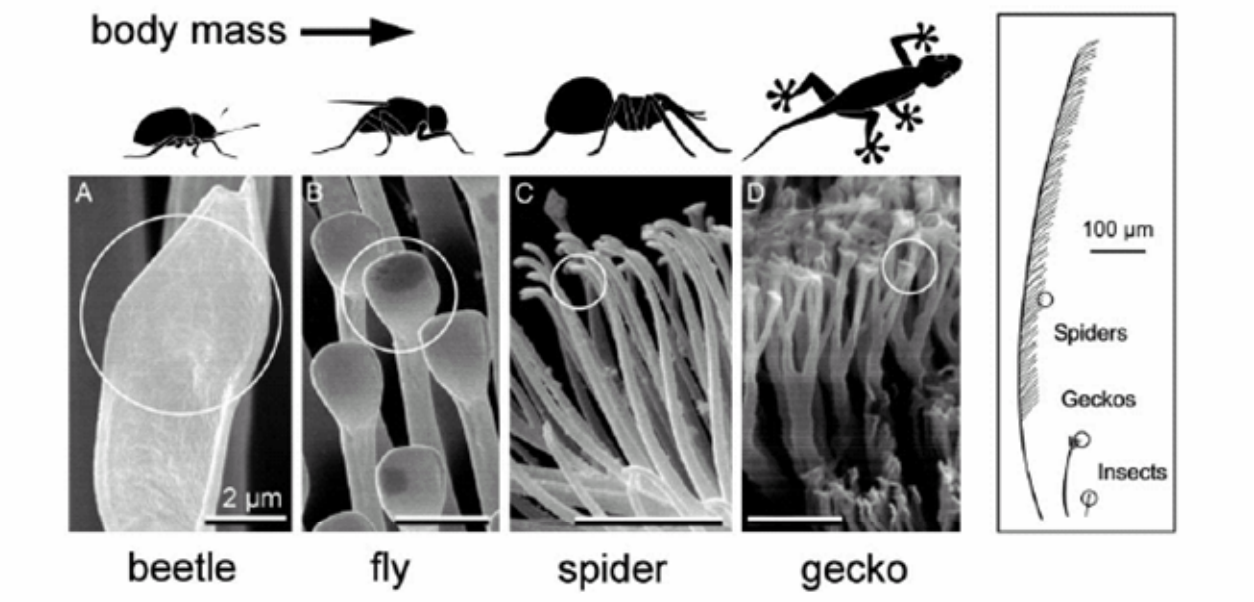
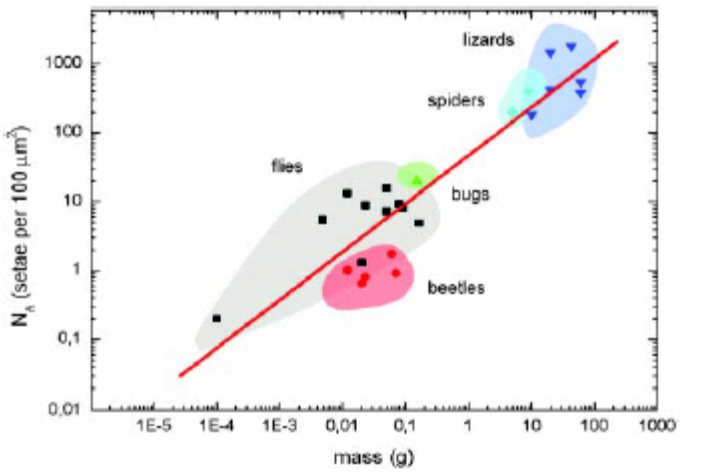


Adhesion Behavior of Nanostructures



Interaction forces:
Mechanical
Van der Waal
Capillary
Sticking fluid



$$d^3 = \frac{12R}{E^*}\{F + 3\pi R\gamma + [6\pi R\gamma F + (3\pi R\gamma)^2]^{1/2}\},$$

$$F_C = \frac{3}{2}\pi R\gamma. \qquad F'_C = \sqrt{n}\cdot F_C.$$

Van der Waal energy 50 to 10 mJ/m^2

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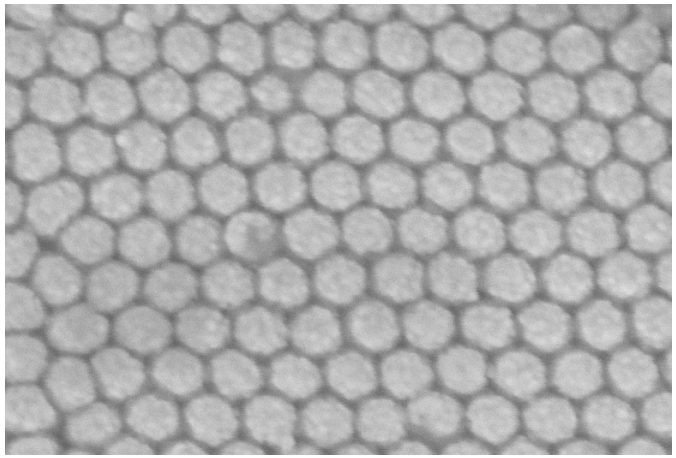
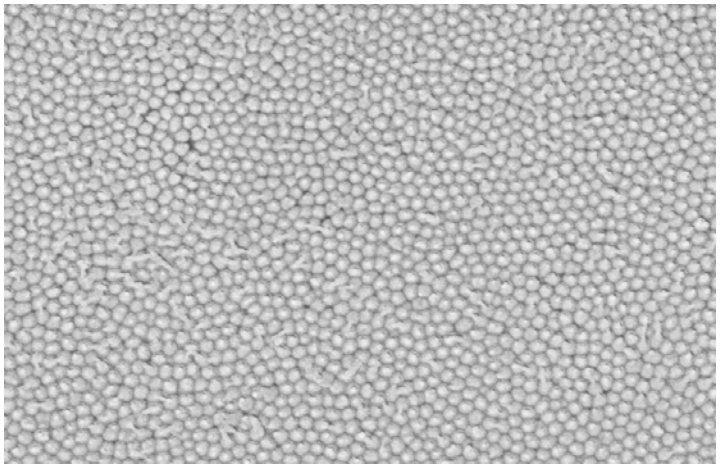
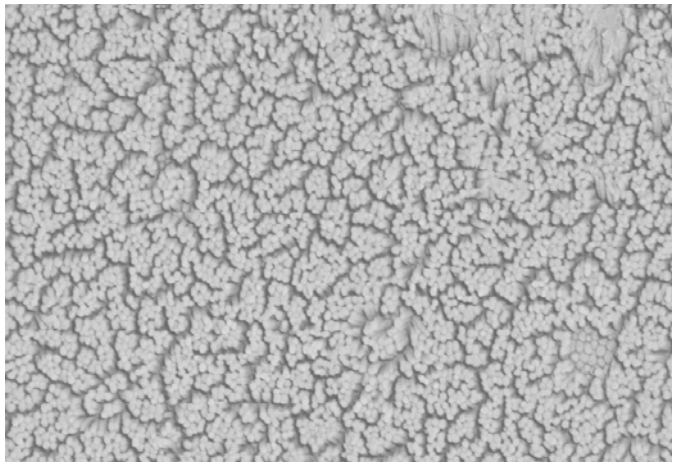
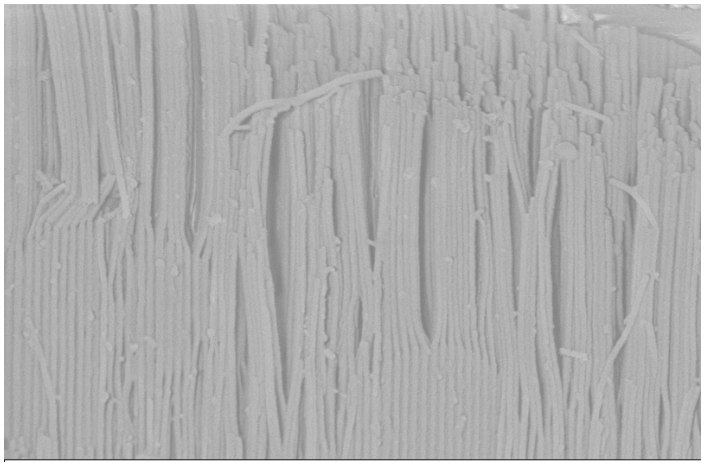
Fabrication of Teflon Nanofibers by Nanoimprint

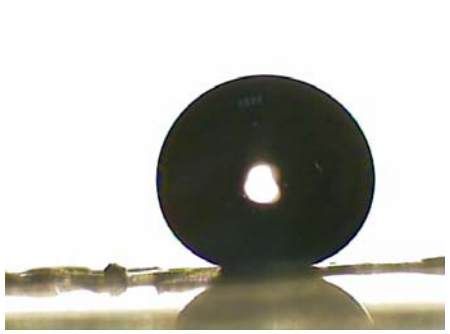






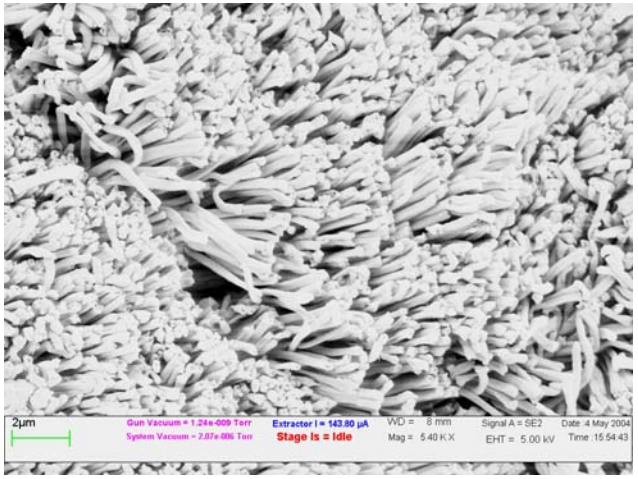


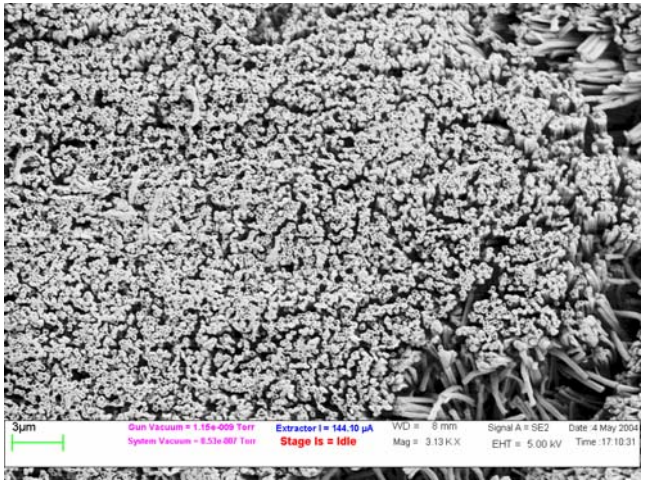
Teflon Nanofibers



CA 160^0

QuickTime?and a
YUV420 codec decompressor
are needed to see this picture.

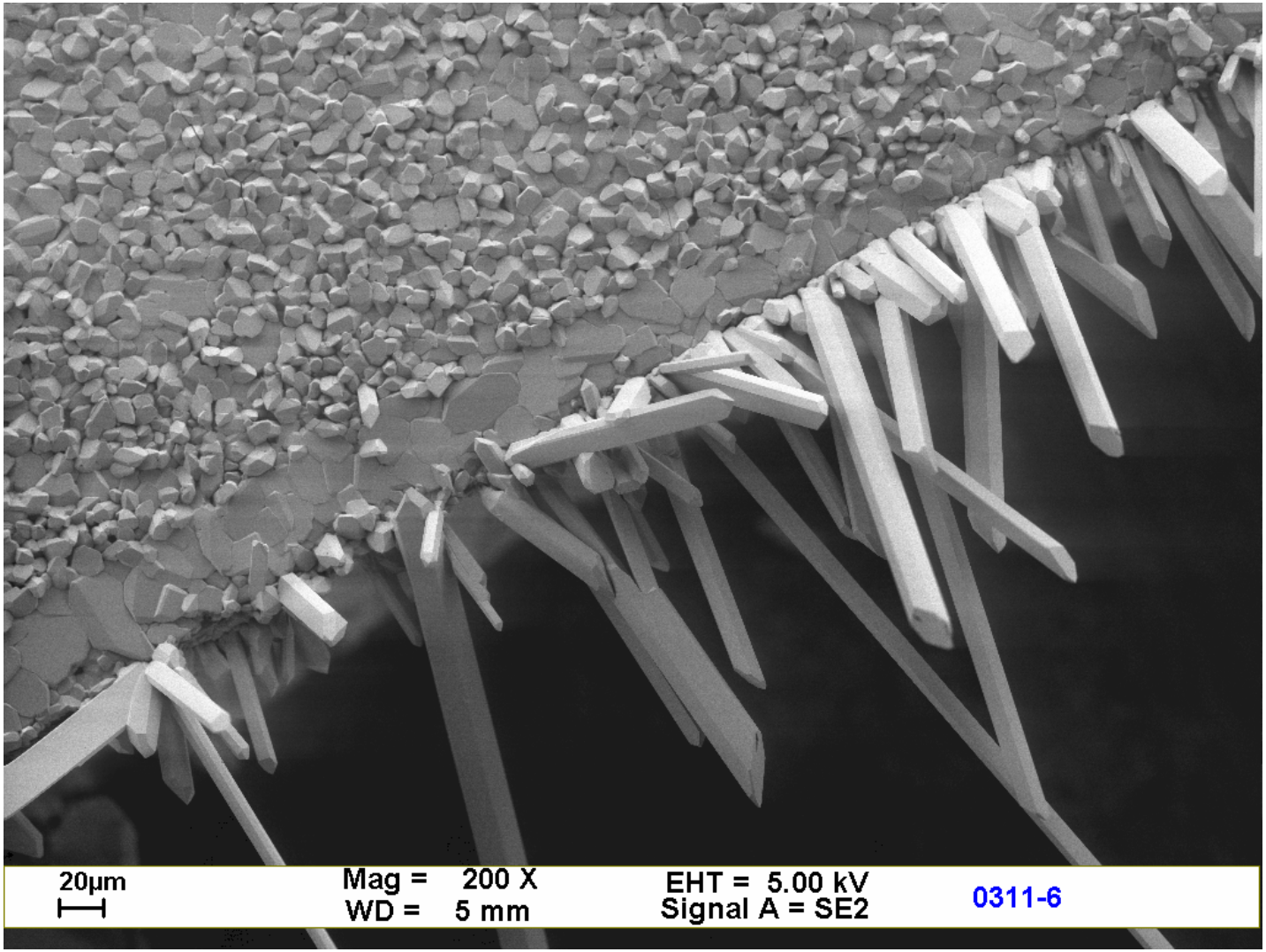




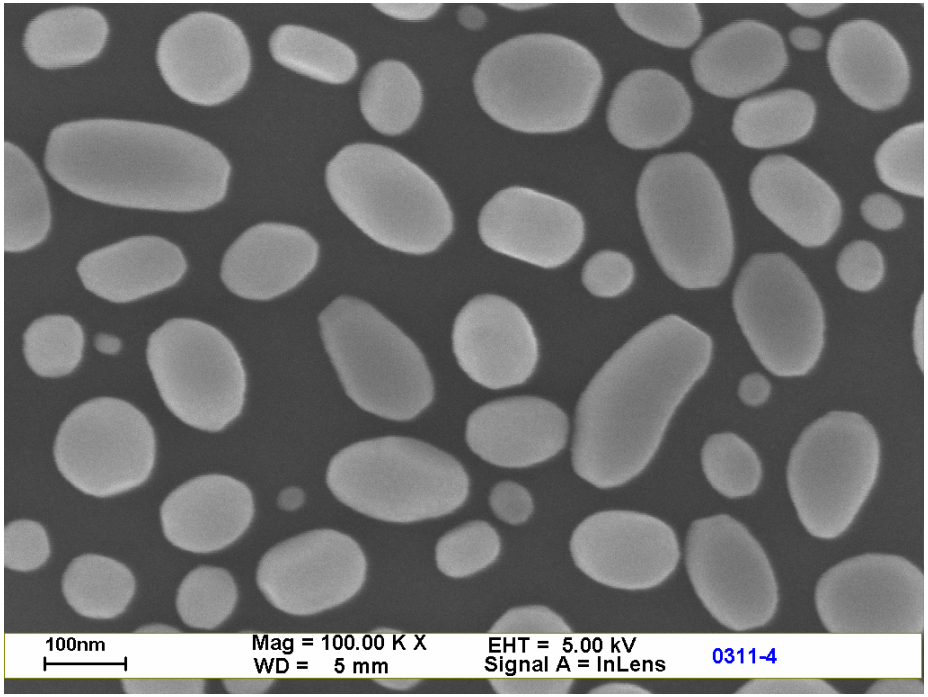
Adhesion of Nanostructured Teflon Tapes

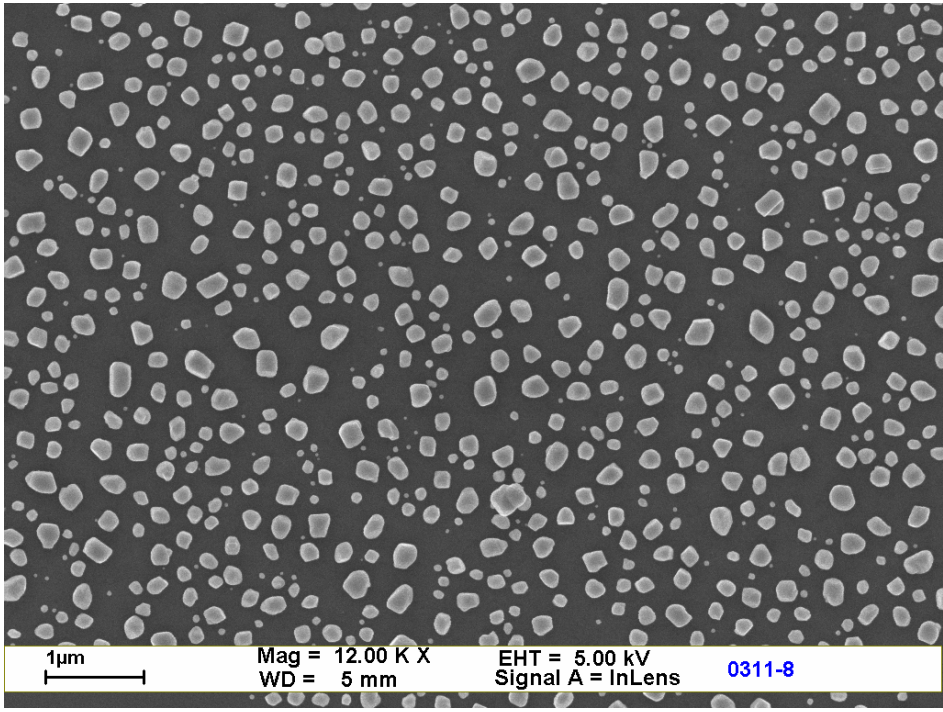
1. 物理蒸氣沉積(Physical Vapor Deposition)

Bi-Te 奈米微粒與奈米線

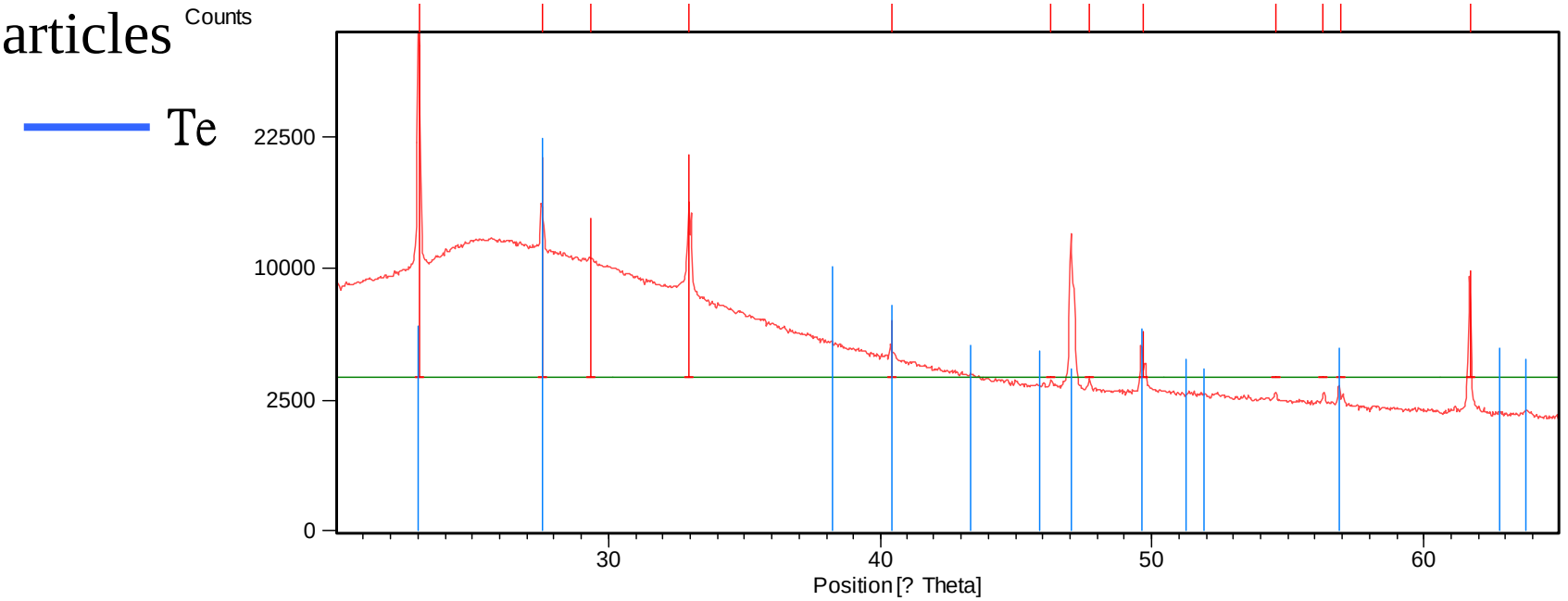


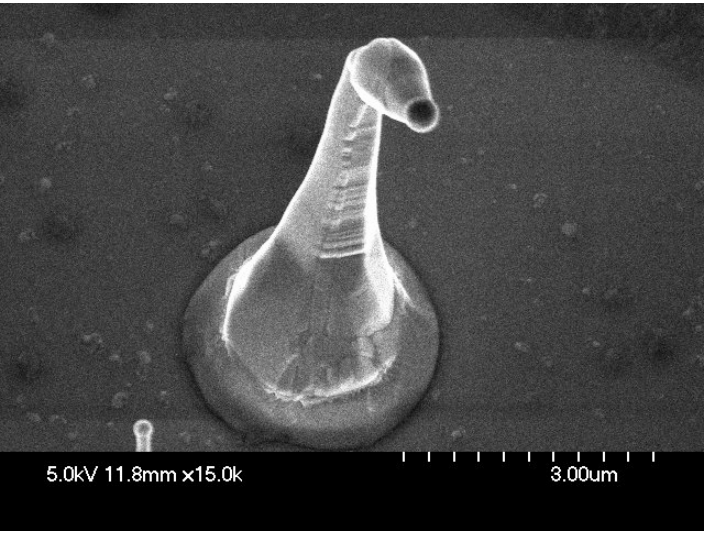
The crystals of Bi-Te were grown at the edge of Si wafer by PVD, the growing mechanism may be related to interfaces among crystals.

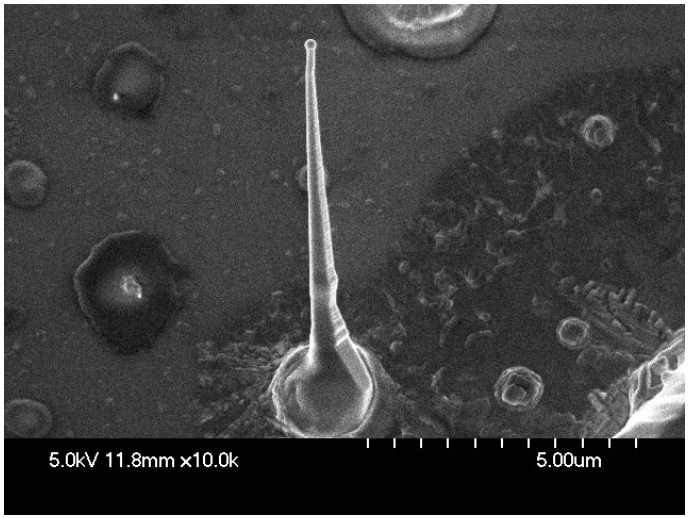


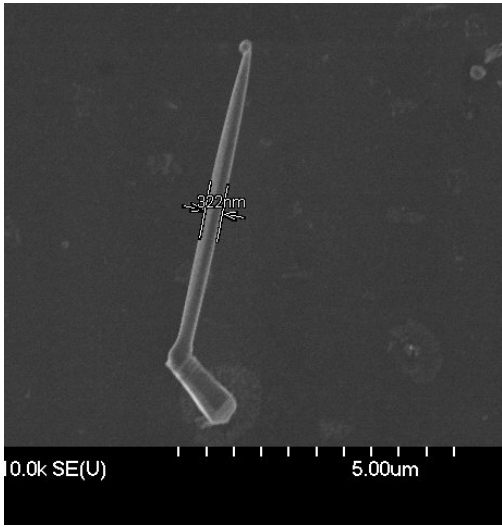


Te particles

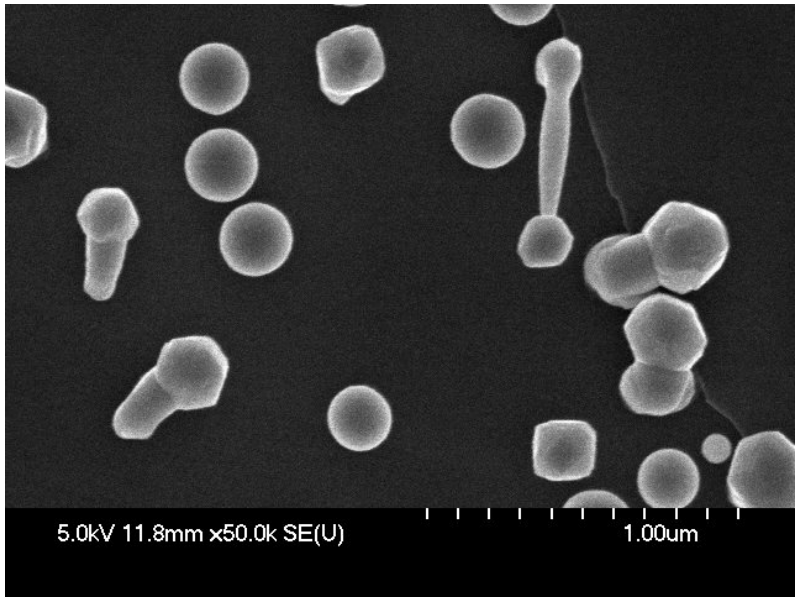


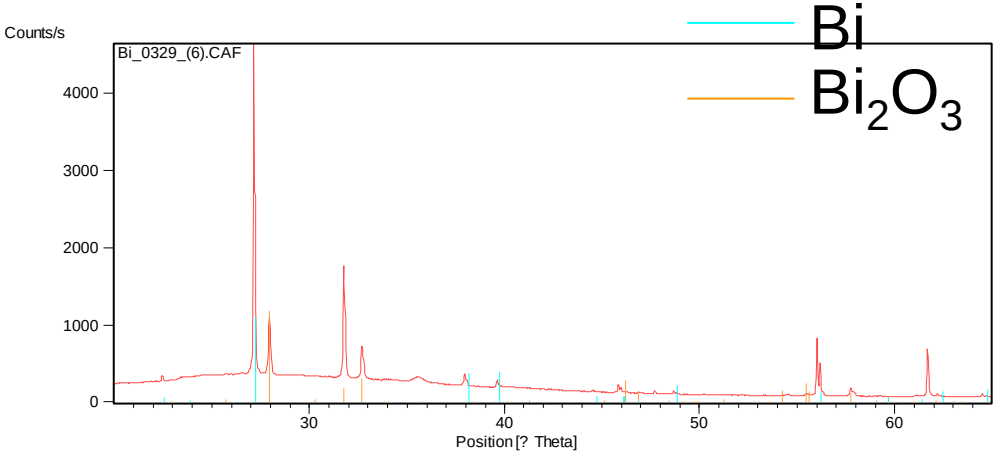




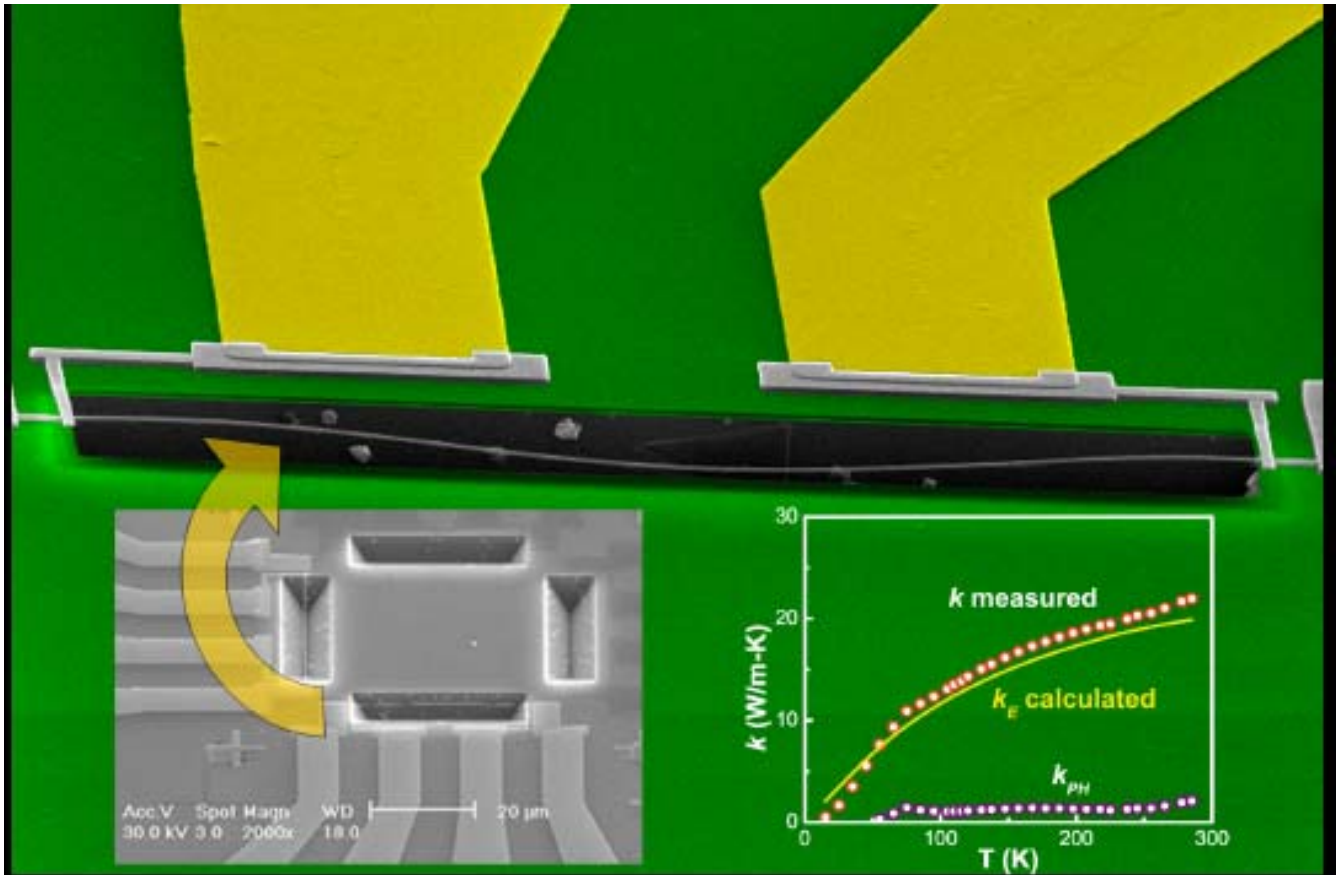


Bi + Bi_2O_3 wire





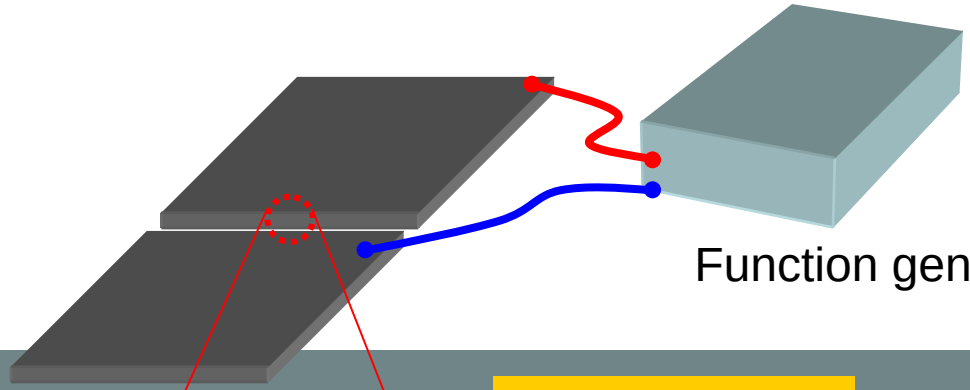
•3. 半導體製程



A suspended single Ni-nanowire (Φ=200 nm L=10 μm) was prepared

The plot will appear the cover of APL 11 Feb 2008 issue

3. Single nanowire manipulation technique

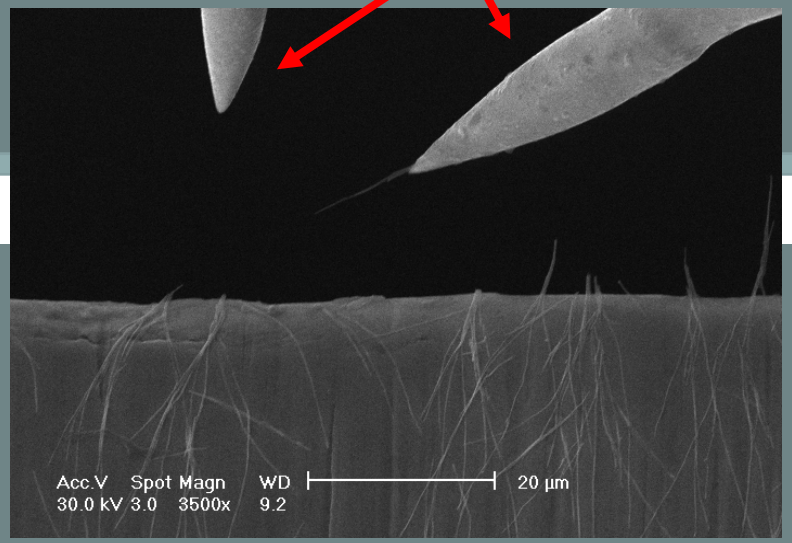


Function generator

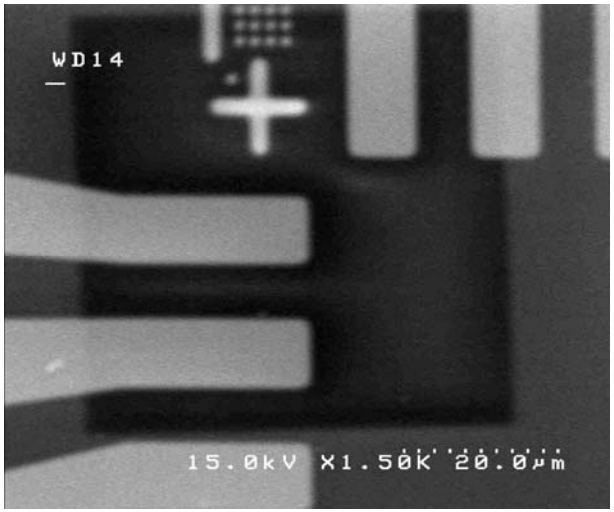
$V=V_0 \sin \omega t$

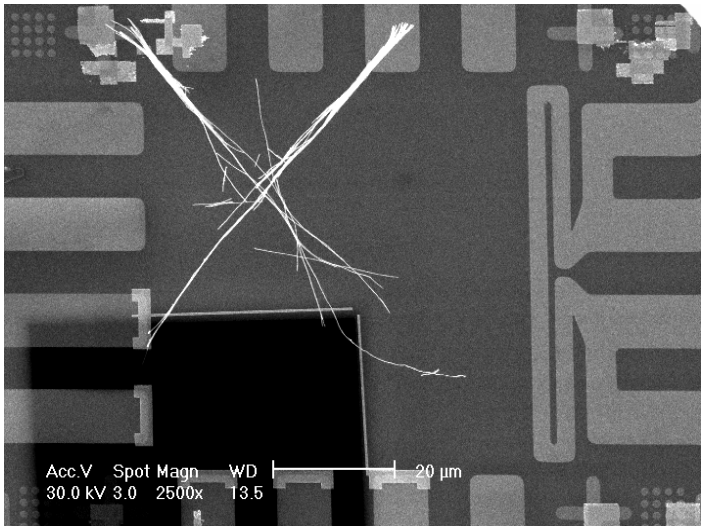
ω=500~1M Hz

Pickup probes

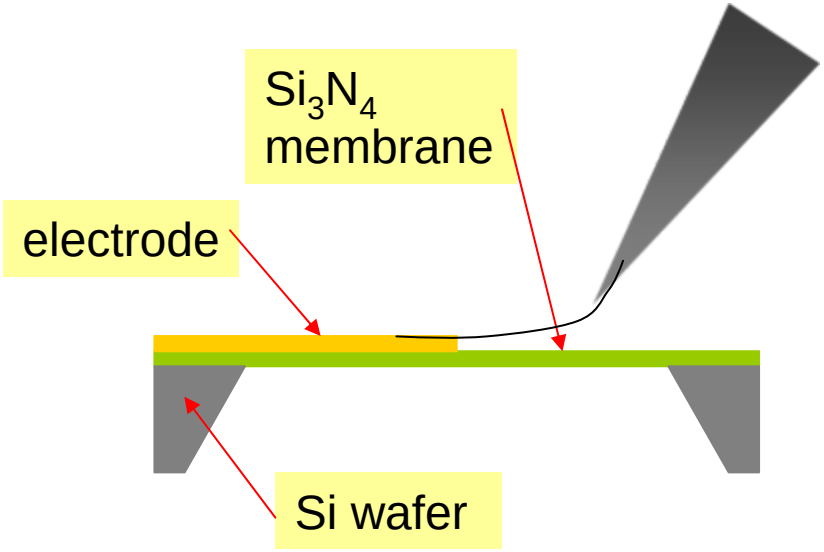


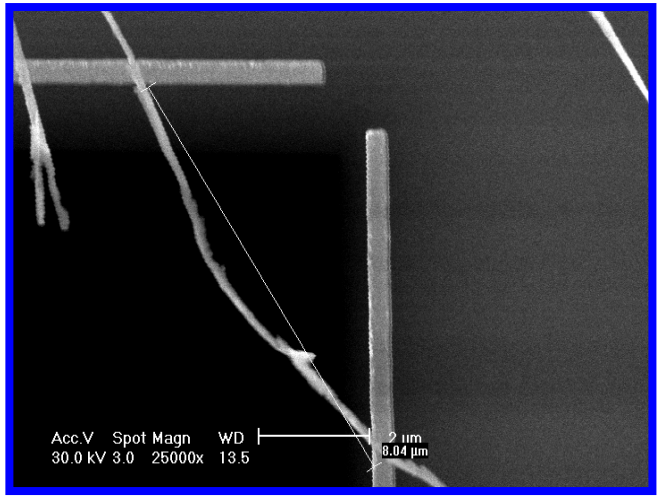
C. Manipulation technique for single nanowire





Bi_2Te_3 nanowire diameter ~ 150 nm, L=10 um





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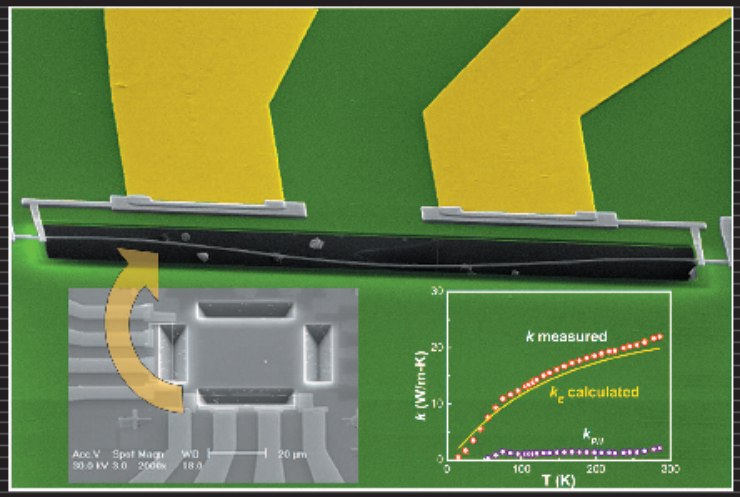

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