

Lecture 15 – Nanofabrication Overview

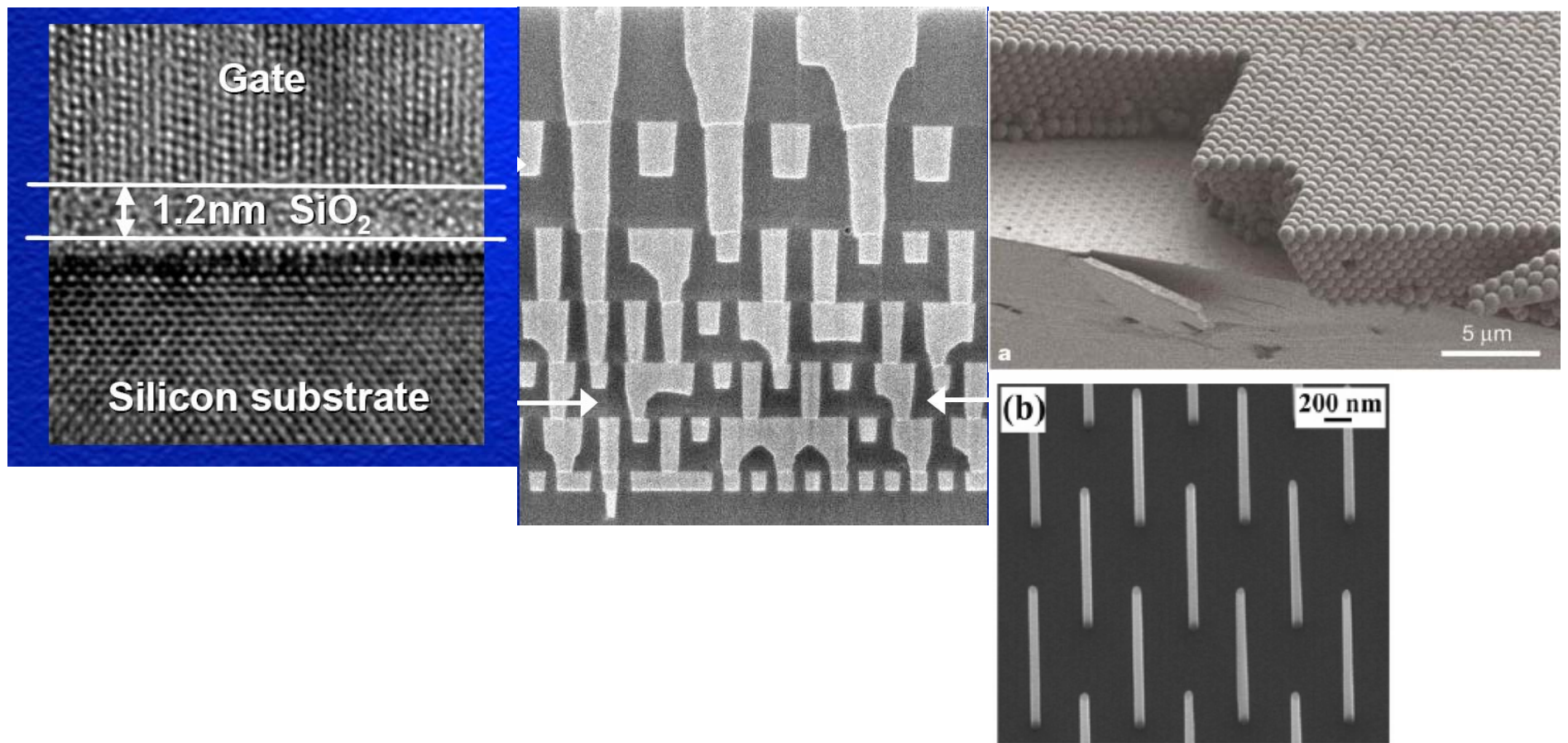
EECS 598-002 Winter 2006
Nanophotonics and Nano-scale Fabrication
P.C.Ku

The scope of our discussions

- We will be discussing fabrication based on solid-state platform, e.g. on semiconductor substrates, glass substrates, plastic substrates, etc.

What is fabrication?

- Fabrication is to put the “right” material at the “right” location and with “right” size and shape.



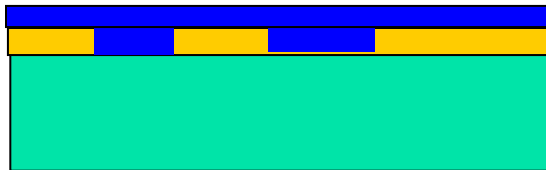
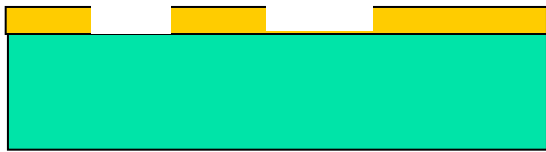
Different approaches

- Top-down (litho/etch)



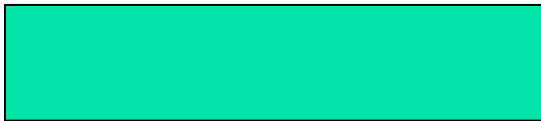
Different approaches

- Top-down (damascene/CMP)



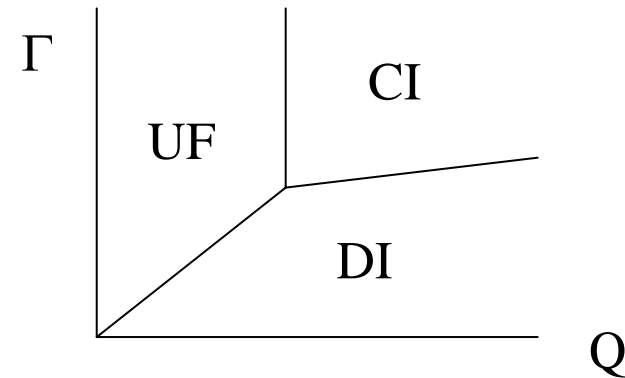
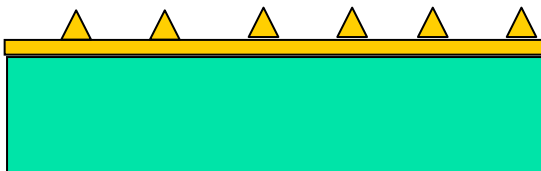
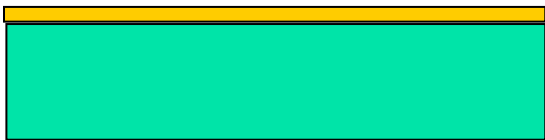
Different approaches

- Top-down (liftoff)



Different approaches

- Bottom-up (strain-induced self-assembly)



Q : amount of deposited material

$$\Gamma = \Delta E_{\text{dis}} / \Delta E_{\text{surf}}$$

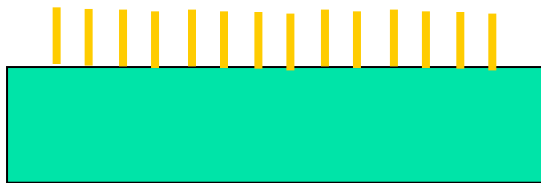
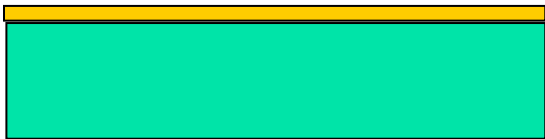
CI = coherent islands

DI = dislocated islands

UF = uniform film

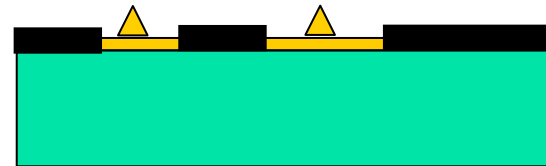
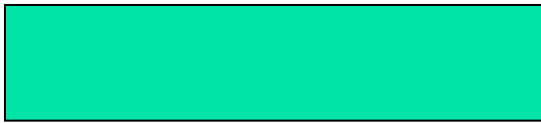
Different approaches

- Bottom-up (catalyst-induced self-assembly)



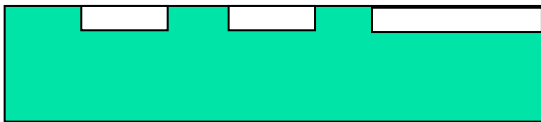
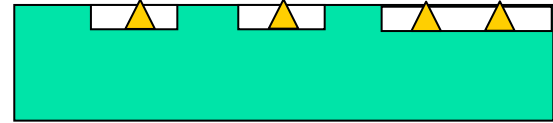
Different approaches

- Hybrid (selective-area growth)



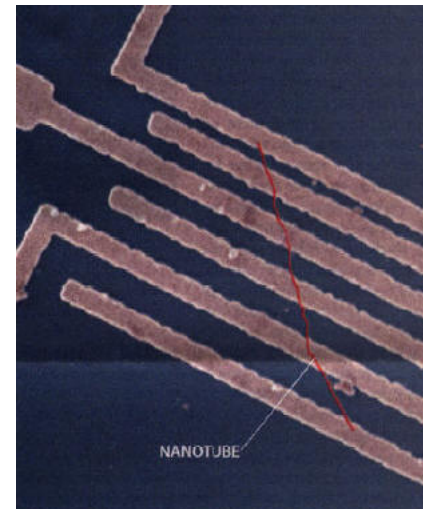
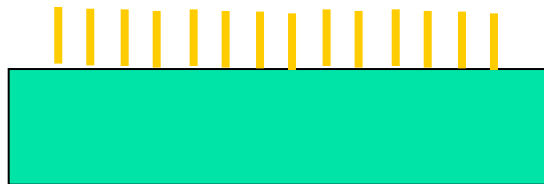
Different approaches

- Hybrid (patterned substrate overgrowth)



Different approaches

- Hybrid (separate assembly)



http://www.mtmi.vu.lt/pfk/funkc_dariniai/nanostructures/nanotubes.htm

Typical chip making process

- Link: <http://www.infras.com/Tutorial/sld001.htm>

Schedule for the rest of the semester

- Patterning
 - Lithography/etch/liftoff
 - CMP/damascene
- Thin film deposition
- Self assembly
 - In-situ growth
 - Ex-situ assembly