Nanoimprint Lithography

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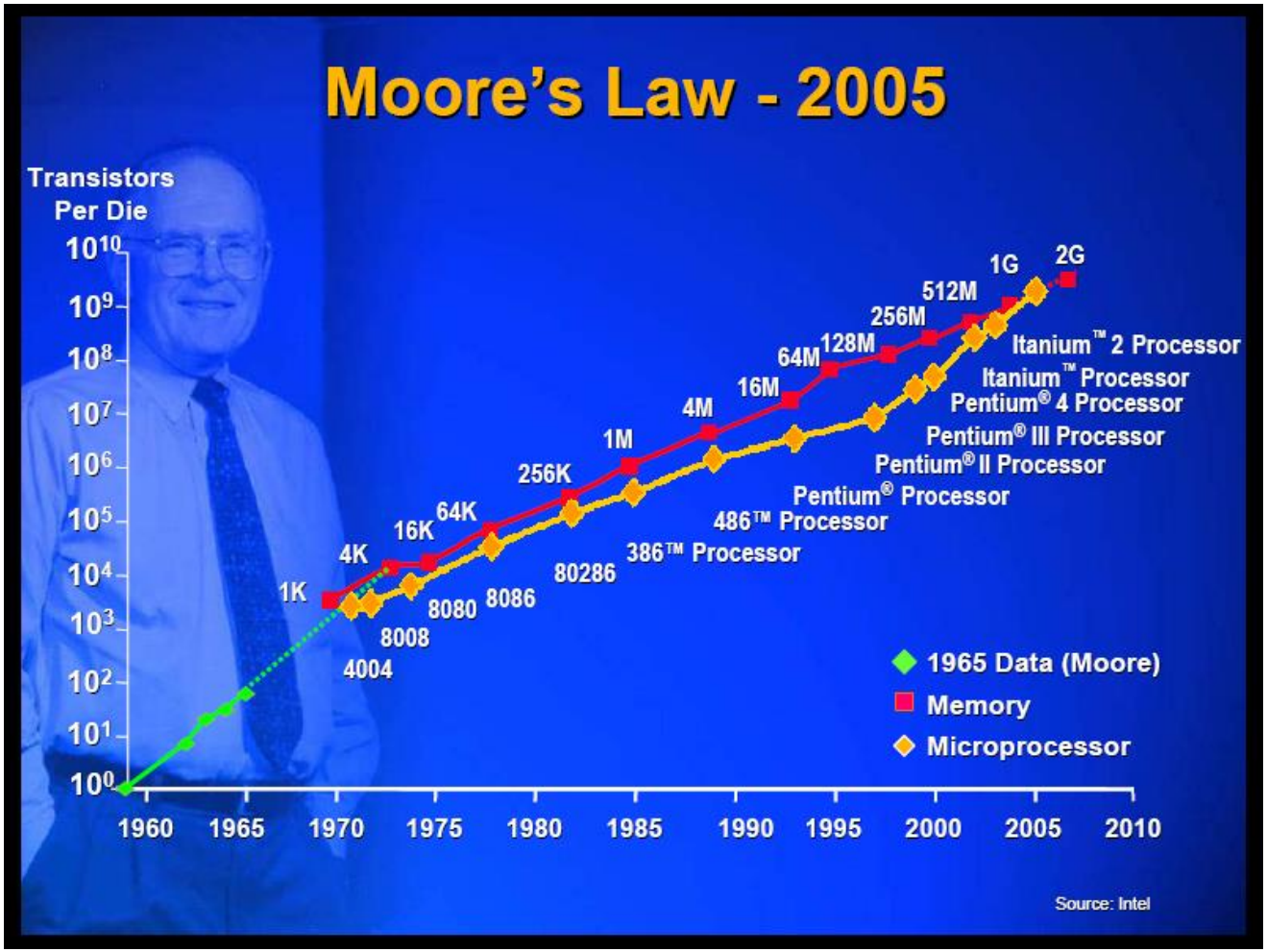
Shaw Group Meeting

05/02/2013



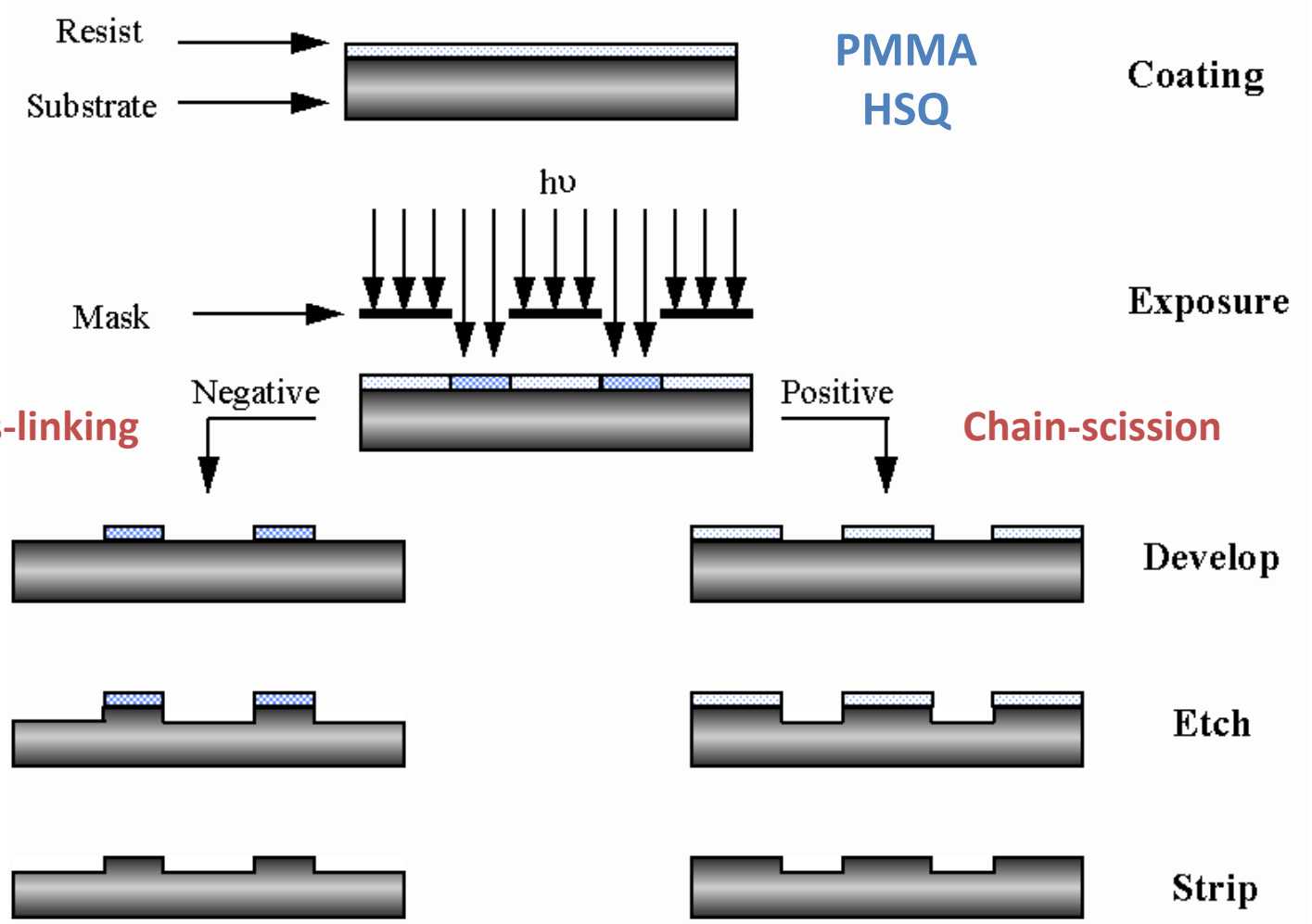
- *The number of transistors on integrated circuits doubles approximately every two years*
- When will it end?
  - **Some sources say we are at the "inflection point" for this trend!**

Requirements of Lithography

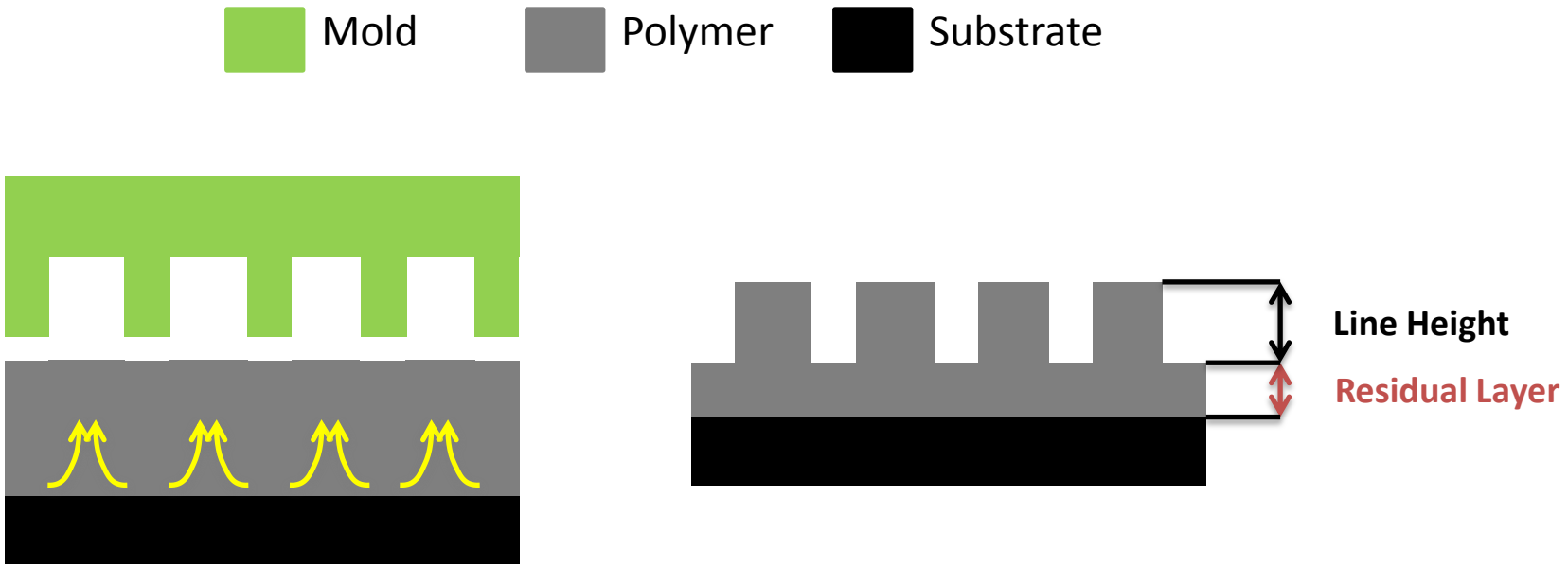
- **Critical Dimension (CD) control:**
  - Sizes must be controlled within wafer and from wafer-to-wafer during fabrication
- **Overlay:**
  - For high yield, alignment must be precisely controlled
- **Defect Control:**
  - Other than designed pattern, no additional patterns must be imaged; avoid proximity effects
- **Low Cost:**
  - Tool, resist, mask; fast step-and-repeat

Muhannad Bakir Introduction to Nanoimprint Lithography (2006)

Conventional Photolithography

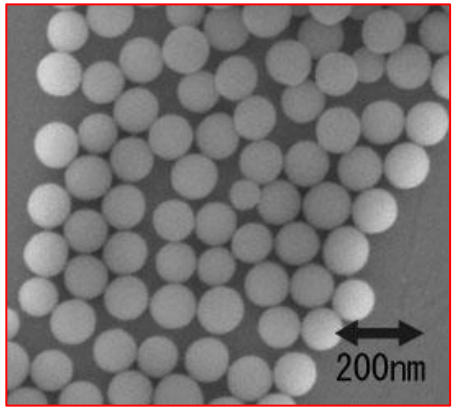


Nanoimprint Lithography (NIL)



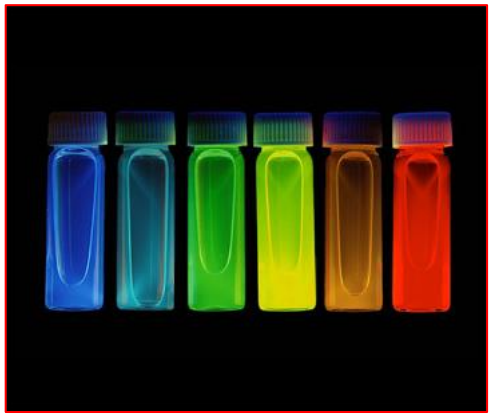
- Thermal NIL is a three-dimensional patterning technique with numerous application in nanotechnology
- No need for expensive/complex optics or high-energy radiation sources
- However, **relies on other lithographic techniques for template fabrication**
- Control over adhesion between mold and polymer resist is important!

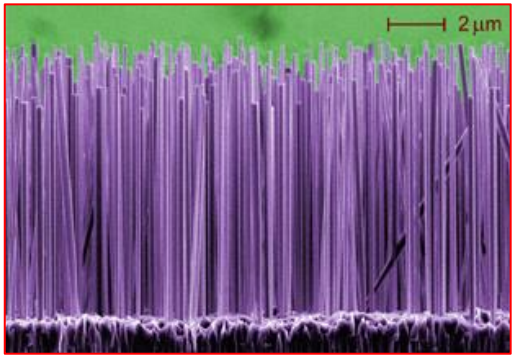
Interesting Research



Nanoparticles

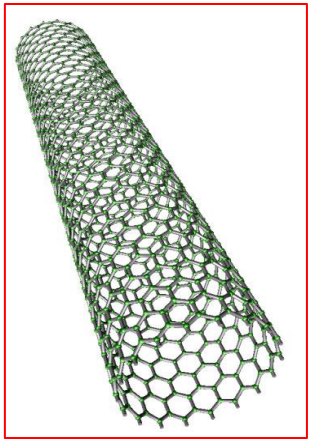
Quantum Dots





Nanowires

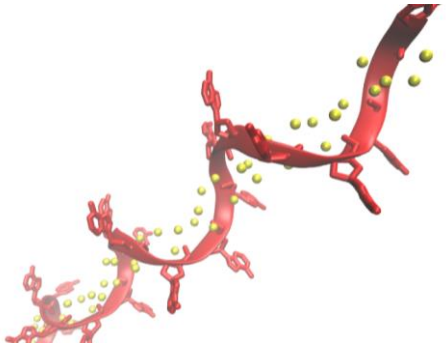
CNTs



- Exploiting their properties is challenging!
  - Not amenable to organization on surfaces in interconnected circuits, networks or arrays
- Self-assembled DNA nanostructures can be used as scaffolds to organize small functional nanocomponents

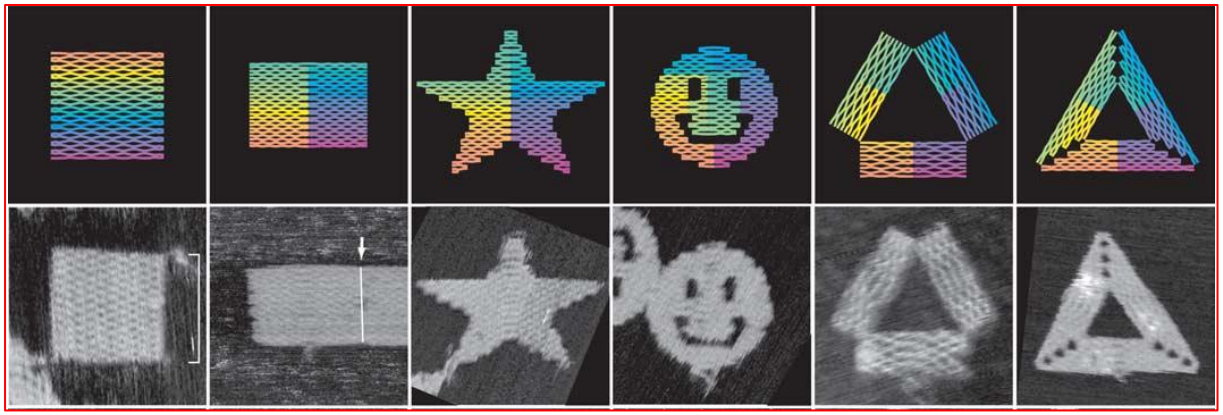
Images obtained from www.google.com

DNA Origami



- Large enough for conventional lithographic techniques
- DNA is a charged molecule **=>** hydrophilic surfaces

- The DNA origami are 2D structures obtained by folding a long genomic ss-DNA by means of hybridization with many short staples (synthetic ss-DNA); **165 × 165 nm**
- Use “sticky ends” to attach functionalized nanostructures (CNTs, nanoparticles, etc.)



Paul Rothemund / Nature|Vol. 440|16 March 2006

Image obtained from www.google.com