

“Understanding Nanotechnology” (026.023) Final exam (11/27/06)

PM 1:00 – 2:15

1. Compare “Top-down” and “Bottom-up” approaches in terms of pattern size, fabrication speed, patterned area, and defect control.
2. In photolithography, if you want to achieve high resolution, you need to use UV light with small wavelength. What are two major problems using UV lights such as KrF (248 nm) or ArF (193 nm)?
3. Explain nanoimprint lithography step by step. What are the technical issues in this technique?
4. Can you devise a simple, hybrid experiment combining top-down and bottom-up methods? For example, demonstrate one example how to obtain uniform 30 nm features using photolithography and 10 nm nanoparticles. Assume that the current resolution limit of photolithography is 50 nm. You need to show detailed procedure for full credits.
5. Dip-pen nanolithography (DPN) is a kind of hybrid method combining nanolithography and self-assembly. Why? Write down parameters that can determine the pattern size in dip-pen nanolithography.
6. What is biomimetics? Explain how nanotechnology can be used in biomimetics. Two examples would be sufficient.
7. In nature, there are basically four representative functions that nanostructures can provide. What are they?
8. The combination of nano and biotechnologies has led to the advent of “Nanobiotechnology”. Why nanotechnology is directly applied to biotechnology? Write down your answer in terms of size and device aspect.
9. What is lab on a chip (LOC)? Briefly explain the current trend of LOC for point-of-care applications.
10. Show examples how nanotechnology can be applied to diagnostics and therapeutics. Two examples for diagnostics and therapeutics, respectively.
11. In many of large-area displays, which display is most relevant to nanotechnology? Explain its emission mechanism as compared to traditional technology.
12. Can you show one example where nano, bio, and information technologies should all be merged together? Explain how each technology contributes to your example.
13. Briefly explain the IBM’s millipede project.

Best wishes in your work and studies!