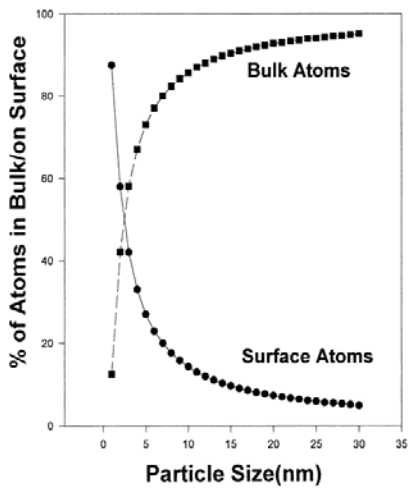
"Understanding Nanotechnology" (026.023) Mid-term exam (10/18/06)

PM 1:00 – 2:15

1. Briefly write down the definition of nanotechnology. Three key words are necessary.
2. What is the Moore's law? Briefly comment on the recent advances in Moore's law.
3. How can nanotechnology solve energy problems, which are considered to be one of key issues in current technologies?
4. Nanotechnology has a broad range of impacts not only on engineering and science but also on human sciences, finances, laws, and others. Why? What could be appropriate future efforts that may lead to a successful merger between different academic areas?
5. Scanning probe microscope (SPM) is a nanoscopic eye (tool) that can enable us to see nanoscale worlds. What are the two different types of SPM? What is the scanning mechanism?
6. With regard to Feynman's lecture, can you do the writing on nanoscale? How is it possible? Describe the tool and its advantages and disadvantages.
7. Briefly comment on the potential threats of nanoparticles.
8. Can you come up with an example of nanotechnology well before people started to mention nanotechnology? (extra credits may be given to an example that is not present in lecture notes)
9. What could be the largest force in nanoscale world? Describe one example to support your answer by comparing with gravity (some calculations may be of help).
10. Describe a few examples that are related to an enormous surface-to-volume ratio as the particle size goes smaller. With regard to a picture on the right, why does the number of surface atoms drastically decrease as the particle size increases? What does this imply when synthesizing nanoparticles?



11. What is the role of “Nano Physics” and “Nano Chemistry”? Briefly explain.
12. Describe one strategy to synthesize nanoparticles in a controlled fashion. You may show other methods that are not mentioned in the lecture.
13. The largest mammal known to live on earth is an African elephant, mammoth whereas the smallest mammal is a hummingbird. Briefly explain this in terms of scaling concepts.
14. Quantum size effects may be summarized in wave-particle duality. Mention the evidence of particle and wave character of light, respectively.
15. In the movie, “Spider Man”, mention a few examples for nanotechnology applications (you can point out other scenes that were not introduced in the lecture if you want).