

PHYS 4574 - Nanotechnology

Reading List - Spring 2006

A. NANOSCALE FABRICATION AND CHARACTERIZATION

1. Nanolithography

A1: Lithography for Semiconductor Technology

Reference: C. Ngo, C. Rosilio, Nuclear Instruments and Methods in Physics Research B, Vol. 131 22-29 (1997).

A2: An Overview of Ion Beam Lithography for Nanofabrication

Reference: U. Tandon, Vacuum, Vol. 43, No. 3, 241-251 (1992).

A3: Nanofabrication Using Electron Beam and Its Application to Nanometer Devices

Reference: S. Matsui, in Handbook of Nanostructured Materials and Technology, Vol. 3 (Electrical Properties), Ch. 11, 555-564, 582-583 (2000).

A4: Sub-10 nm Imprint Lithography and Applications

Reference: S. Chou, P.R. Krauss, W. Zhang, L. Guo, L. Zhuang, J. Vac. Sci. Tech. B, Vol. 15, 2897-2904 (1997).

2. Self-Assembly and Self-Organization

A5: Fuzzy Nanoassemblies: Toward Layered Polymeric Multicomposites

Reference: G. Decher, Science, Vol. 277, 1232-1237 (1997).

A6: Nanostructured Thin Films via Self-Assembly of Block Copolymers

Reference: G. Krausch, R. Magerle, Advanced Materials, Vol. 14, 1579-1583 (2002).

A7: A DNA-based Method for Rationally Assembling Nanoparticles into Macroscopic Materials

Reference: C. Mirkin, R. Letsinger, R. Mucic, J. Storhoff, Nature Vol. 382, 607-609 (1996).

A8: Organization of Nanocrystal Molecules Using DNA

Reference: A. Alivisatos, et al, Nature Vol. 382, 609-611 (1996).

A9: DNA-Templated Assembly and Electrode Attachment of a Conducting Silver Wire

Reference: E. Braun, Y. Eichen, U. Sivan, G. Ben-Yoseph, Nature Vol. 391, 775-778 (1998).

3. Scanning Probe Microscopy

A10: Scanned Probe Microscopes

Reference: H. Wickramasinghe, Scientific American, Vol. 261, No. 4, 98-105 (1989)

A11: Atomic Force Microscopy

Reference: D. Rugar and P. Hansma, *Physics Today*, Vol. 43, No. 10, pp 23-30 (1990).

A12: Breaking the Diffraction Barrier: Optical Microscopy on a Nanometer Scale

Reference: Betzig E., J.K. Trautman, T.D. Harris, J.S. Weiner, and R.S. Kostelak, *Science* Vol 251, 1468-1470 (1991).

A13: Field-induced Nanometer to Atomic-Scale Manipulation of Silicon Surfaces with STM

Reference: I Lyo, P. Avouris, *Science* Vol. 253, 173-175 (1991).

B. NANOMATERIALS AND NANOSTRUCTURES

5. Fullerenes

B1: Small-Bandgap Endohedral Metallofullerenes in High Yield and Purity

Reference: Stevenson, S; Rice, G; Glass, T; Harich, K; Cromer, F; Jordan, MR; Craft, J; Hadju, E; Bible, R; Olmstead, MM; Maltra, K; Fisher, AJ; Balch, AL; Dorn, HC. , *Nature*, **401**, 55–57 (1999).

6. Carbon Nanotubes

B2: Carbon Nanotubes

Reference: P. Ajayan, in Handbook of Nanostructured Materials and Technology, Vol. 5 (Organics, Polymers, and Biological Materials), Ch. 6 , 375-406 (2000).

B3: Nanotubes as Nanoprobes in Scanned Probe Microscopy

Reference: H. Dai, J. Hafner, A. Rinzler, D. Colbert, R. Smalley, *Nature* Vol. 384, 147-150 (1996).

B4: A Carbon Nanotube Field-Emission Electron Source

Reference: W. de Heer, A Chatelain, D. Ugarte, *Science* Vol. 270, 1179-1180 (1995).

B5: Carbon Nanotubes as Molecular Quantum Wires

Reference: C. Dekker, *Physics Today*, Vol. 52, No.5 , 22-28 (1999).

B6: Individual Single-Wall Carbon Nanotubes as Quantum Wires

Reference: S. Tans, M. Devoret, H. Dai, A. Thess, R. Smalley, L. Geerligs, C. Dekker, *Nature* Vol. 386, 474-477, (1997).

B7: Electronic Structure of Atomically Resolved Carbon Nanotubes

Reference: J. Wildoer, L. Venema, A. Rinzler, R. Smalley, C. Dekker, *Nature* Vol. 391, 59-62 (1998).

7. Quantum Dots

B8: Semiconductor Quantum Dots: Progress in Processing

Reference: D. Duval, S. Risbud in "Handbook of Nanostructured Materials and Technology", Vol. 1 (Synthesis and Processing), Ch. 10 , 481-500 (2000).

C. NANOSCALE AND MOLECULAR ELECTRONICS

9. Advances in Microelectronics

C1: CMOS Operation

Reference: J.D. Plummer, M.D. Deal, P.B. Griffin, "Silicon VLSI Technology," 33-39 (2000).

C2: Nanotubes for Electronics

Reference: P. Collins, P. Avouris, Scientific American Vol. 283, No. 6, 62-69 (2000).

C3: Single- and Multi-Wall Carbon Nanotube Field-Effect Transistors

Reference: R. Martel, T. Schmidt, H. Shea, T. Hertel, P. Avouris, Appl. Phys. Lett. Vol. 73, 2447-2449 (1998).

C4: Carbon Nanotube Inter- and Intramolecular Logic Gates

Reference: V. Derycke, R. Martel, J. Apenzeller, P. Avouris, Nano Letters Vol. 1, 453-456 (2001).

10. Molecular Electronics

C5: Computing with Molecules

Reference: M. Reed, J. Tour, Scientific American Vol. 282, No. 6, 86-93 (2000).

C6: The Electrical Measurement of Molecular Junctions

Reference: M. Reed, C. Zhou, M. Deshpande, C. Muller, T. Burgin, L. Jones, J. Tour, in Molecular Electronics: Science and Technology, pp. 133-144 (1998).

C7: Conductance of a molecular junction

Reference: M. Reed, C. Zhou, C. Muller, T. Burgin, J. Tour, "Conductance of a Molecular Junction", Science Vol. 278, 252-254 (1997).

C8: Large On-Off Ratios and Negative Differential Resistance in a Molecular Electronic Device

Reference: J. Chen, M. Reed, A. Rawlett, J. Tour, Science Vol. 286, 1550-1552 (1999).

11. Single-Electron Devices

C9: Artificial Atoms

Reference: M. Kastner, Physics Today, Vol. 46, No. 1, 24-31 (1993).

C10: Observation of Quantum Effects and Coulomb Blockade in Silicon Quantum Dot Transistors at Temperatures Over 100 K

Reference: E. Leobandung, L. Guo, Y. Wang, S. Chou, Appl. Phys. Lett., Vol. 67, 938-940 (1995)

C11: Room Temperature Operation of a Single Electron Transistor Made by the Scanning Tunneling Microscope Nanooxidation Process for the TiO_x/Ti System

Reference: K. Matsumoto, M. Ishii, K. Segawa, Y. Oka, B. Vartanian, S. Harris, Appl. Phys. Lett., **68** 34-36 (1996).

C12: A Single-Electron Transistor Made from a Cadmium Selenide Nanocrystal

Reference: D. Klein, R. Roth, A. Lim, A. Alivisatos, and P. McEuen, *Nature* **389** 699-701 (1997).

C13: A Silicon Single-Electron Transistor Memory Operating at Room Temperature

Reference: L. Guo, E. Leobandung, S. Chou, *Science* **275**, 649-651 (1997).

D. NANOTECHNOLOGY IN MAGNETIC SYSTEMS

12. Quantum Computing

D1: Quantum Information and Computation

Reference: C.H. Bennett, D.P. DiVincenzo, *Nature* **404**, 247-255 (2000).

14. Elements of Magnetic Storage

D2: The Future of Magnetic Data Storage

Reference: Thompson, D.A., Best, J.S. *The Future of Magnetic Data Storage*: IBM J. Res. Dev. Vol. 44 No. 3, May 2000.

D3: Large Area High Density Quantized Magnetic Disks Fabricated Using Nanoimprint Lithography

Reference: Chou, S.Y. et al., *J. Vac.Sci. Technol.B* 16 (6), 3825-3829 (1998).

D4: Synthesis of Monodisperse Cobalt Nanocrystals and their Assembly into Magnetic Superlattices

Reference: Murray, C.B., Sun, S., *J.Appl. Phys.* 85 (8), 4325-4330 (1999).

E. NANOTECHNOLOGY IN INTEGRATIVE SYSTEMS

15. Introduction to Integrative Systems

E1: The Broad Sweep of Integrated Microsystems

Reference: McWhorter, P.J., Picraux, S.T., *IEEE Spectrum*, p 24-33, December 1998.

E2: Surface Micromachining for Microelectromechanical Systems

Reference: J.M. Bustillo, R.T. Howe, R.S. Muller, *Proc. IEEE* **86**, 1552-1574 (1998).