PHYS 4574 - Nanotechnology
Reading List - Spring 2009

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. Wickramsinghe, 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 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 TiOx/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).

16. Nanoelectromechanical Systems

E3: Damped and Forced Oscillatory Motion
Reference: H. Young and R. Freedman, University Physics, 10^{th} edition (Addison Wesley, San Francisco, 2000), pp 411-418.

E4: **Measurement of Mechanical Resonance and Losses in Nanometer Scale Silicon Wires**
Reference: Carr, D.W.; Evoy, S.; Sekaric, L; Craighead, H.G.; Parpia, J.M., Appl. Phys. Lett. 75, 920-922 (1999).

E5: **A Nanometer-Scale Mechanical Electrometer**

Reference: Cleland, A. N., Roukes, M.L., Nature 392, 160-162, (1998).

E6: **Translating Biomolecular Recognition into Nanomechanics**
Reference: Fritz, J; et al., Science 288, 316-318 (2000).

F. NANOTECHNOLOGY IN OPTOELECTRONICS

18. Quantum-Confined Optoelctronic Systems

F1 : **Basics of Optoelectronic pn-Junction Devices**
Reference: Fukuda, Optoelectronic Devices, pgs 1-7.

F2 : **LED and Semiconductor Lasers**
Reference: Sze, S.M., "Physics of Semiconductor Devices": pp 681-689 & 704-711.

F3: **Red-Emitting Semiconductor Quantum Dot Lasers**
Reference: S. Fafard, K. Hinzer, S. Raymond, M. Dion, J. McCaffrey, Y. Feng, and S. Charbonneau, Science Vol. 274, pp 1350-1353 (1996)

F4: **Semiconductor Nanocrystals as Fluorescent Biological Labels**
Reference: Alivisatos, A.P., et al. Science vol. 285, 2013-2016 (1998).

19. Organic Optoelectronic Nanostructures

F5: **Improved Morphology of Polymer-Fullerene Photovoltaic Devices with Thermally-Induced Concentration Gradients**
Reference: M. Drees, R.M. Davis, J.R. Heflin, J. Appl. Phys. **97**, 036103:1-3 (2005).

F6: **Hybrid Nanorod Polymer Solar Cells**
Reference: W.U. Huynh, J.J. Dittmer, A.P. Alivisatos, Science **295**, 2425-2427 (2002).

F7: **Traveling Wave Electro-optic Phase Modulators Based on Intrinsically Polar Self-Assembled Chromophoric Superlattices**
Reference: Y.G. Zhao *et al*., Appl. Phys. Lett. **79**, 587-589 (2001).

F8: **Efficient, Thermally-Stable, Second Order Nonlinear Response in Organic Hybrid Covalent/Ionic Self-Assembled Films**
Reference: J.R. Heflin, *et al*., Langmuir **22**,5723-5727 (2006).

20. Photonic Crystals

F9: **Photonic Crystals: Semiconductors of Light**
Reference: E. Yablonovitch, Scientific American, Dec. 2001, pp. 47-55.

G. NANOBIOTECHNOLOGY

22. Biomolecular Motors

G1: **The Way Things Move: Looking Under the Hood of Molecular Motor Proteins**
Reference: Vale, R.D., Milligan, R.A., Science vol. 288, 88-95, April 2000.

G2: **Powering an Inorganic Nanodevice with a Biomolecular Motor**
Reference: R.K. Soong *et al*., Science 290 1555-1558 (2000).

23. Nanofluidics

G3: **Separation of Long DNA Molecules in a Microfabricated Entropic Trap Array**
Reference: J. Han, H.G. Craighead, Science **288**, 1026-1029 (2000).