

MSE 4320
MSE 5390
NANOSCALE MATERIALS

Outline and Topics:

Introduction to the synthesis, properties and applications of thin films, nanoparticles and natural nanomaterials.

Synthesis and Characterization

Thin films - vacuum technology and electrodeposition

Nanoparticles – chemical synthesis

Biomolecular nanoscience

Materials and Properties

Metal nanoparticles- dielectric constant in solids and plasmons

Magnetic nanoparticles- superparamagnetism

Semiconductor nanoparticles- electrons in a box and excitons

Natural nanomaterials – size effect in nature

Applications

Biological and biomedical applications

Recommended Textbook:

Introduction to Nanoscience

by Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, Anil Rao

Publisher: CRC; 1 edition (May 15, 2008)

ISBN-10: 1420048058

ISBN-13: 978-1420048056

Fundamentals of Nanotechnology

by Gabor L. Hornyak, John J. Moore, H.F. Tibbals, Joydeep Dutta

Publisher: CRC; 1 edition (December 22, 2008)

ISBN-10: 1420048031

ISBN-13: 978-1420048032

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Homework: Three lab reports

Grading: Undergraduates:

Lab reports 75%

Final 25%

Graduates:

Lab reports	60%
Final	40%

Tentative Schedule:

Week 1 Overview and Introduction to Nanoscale Materials
Review of Materials Science

Experiment 1: Anodization of Aluminum Films

Week 2 Vacuum Science and Technology
Physical Vapor Deposition (Evaporation)

Week 3 Physical Vapor Deposition (Sputtering)
Lab: Sputtering of Al film

Week 4 Review of Electrochemistry and Anodization
Lab: Anodization (ELB 341)

Week 5 Electrochemical Deposition
Lab: AFM (CCMB)

Experiment 2: Colloidal Gold

Week 6 Review of Optical Properties of Materials
Lab: Synthesis of colloidal gold through electroless deposition (ELB 341)

Week 7 Plasmonics
Lab: UV-Vis spectroscopy
Lab report 1 due

Week 8 Applications
Lab: SEM (CCMB)

Experiment 3: Magnetic Nanoparticles

Week 9 Review of Magnetic Properties of Materials
Lab: Synthesis of Iron Oxide Nanoparticles (ELB 341)

Week 10 Superparamagnetism
Lab: Magnetic Characterization (ELB 341)
Lab report 2 due

Week 11 Applications
Lab: TEM (CCMB)

Lectures on Nanotechnology

Carbon Nanotubes
Quantum Dots
Polymer Nanoparticles
Natural and Bionanoscience