

UNIVERSITY OF ILLINOIS
College of Engineering
Department of Materials Science and Engineering

MSE 487: MATERIALS FOR NANOTECHNOLOGY
Spring 2021

Instructor: Prof. Paul Braun, 2017 MRL, 244-7293, pbraun@illinois.edu
Lecture: Tu-Th 9:30-10:50 am
Office Hours: By appointment
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Office Hours: By appointment
Website: <https://compass2g.illinois.edu/>

Extensive readings from the current literature will be assigned over the semester.

Course Outline: (note, may revise as the course progresses)

Part I. Introduction to Nanoscience and Nanotechnology

Part II. Physical and Chemical Properties at the Nanoscale

Bonding and crystal structure
Thermodynamics at the nanoscale
Electronic properties
Magnetic properties
Optical properties
Mechanical properties

Part III. Synthesis and Characterization Methods

Thin film growth
Self-assembly and self-organization
Photolithography
Examples of applications of characterization methods

Part IV. Selected Applications of Materials for Nanotechnology (tentative)

Carbon nanotubes
Metallic and semiconductor nanocrystals
Ferroelectrics and multiferroics
Nanostructuring by severe plastic deformation
Nanomechanics of biological systems

Grading: **1000 points total (subject to revision if number of assignments changes).**

420 points: 2 homeworks (60 pts. each) and 5 critical paper reviews (60 pts. each).

200 points: breakout group presentations (20 pts. each).

50 points: Final presentation attendance.”

3 Credit Option: Term paper (**330 pts.**)

4 Credit Option: In-class research proposal presentation (**180 pts.**) & written proposal (**150 pts.**)

Note: Students are expected to participate in guest lectures, breakout group discussions, and final presentations. Attendance is mandatory on those days. Attendance at final presentations worth 50 pts. spread over the presentation day(s).

COURSE ASSIGNMENTS

1. Homework assignments (first two weeks).

2. Critical reviews (starting week 3).

- A list of published papers will be assigned every other week for review. You will select one paper from the list provided and submit a written critical review of the paper, adding personal comment(s) prompted by your reading, and supported by some additional source (e.g., papers cited by the article you summarized, papers you found by searching the literature...). A template to review the paper will be provided.

3. Review assessments (starting week 4).

- You will submit a written critical assessment of two of your classmate's reviews, including an overall grade, and personal comment(s) prompted by your reading supported by literature sources. Failure to complete this will result in you being assigned a grade of "0" for your review. Should your assessment be superficial or low quality, I reserve the right to significantly reduce your grade on your review.

4. Group discussion and in-class reports (Starting week 3).

- You will be divided into fixed groups of 5-10 students to critically analyze specific components of scientific research throughout the semester. Content for each round will be drawn from a recent guest lecture or an assigned paper important to nanotechnology (separate from the review process).
- Following the breakout time (first ~30 min of lecture on the indicated dates) your team will be responsible for leading in-class discussion on a different element of the assigned work (prior work, background and motivation, methods, results, or discussion) and you will create a short presentation to report in class. Rotating delegates will be chosen from each group for each presentation, ensuring every student will lead at least once.
- Teams will be asked to perform peer evaluation several times during the semester; if individuals on a team are not participating fully, points will be deducted from their scores (hopefully this will not need to happen).

5. Term paper (3-credit option) or Research proposal (4-credit option).

- Each student will prepare and submit either a term paper (3-credit option) or a research proposal (4-credit option). The paper/proposal should consist of 10 to 15 pages of text plus figures and references on a topic of your choice. Note, "science" focused papers/proposals are generally better than "technology" focused proposals.
- All thesis MS and PhD students must list their research advisor's name on their research proposal. The proposal must be different than your or your group's current research.
- Pre-proposal (graduate students) or term paper abstract (undergraduate students) will be due by **Thursday March 4th**.
- Term papers will be due on Compass by the start of class on **Tuesday May 4th** (last day of class), but will be accepted without penalty until noon on the day scheduled for the course final, **Tuesday May 11th**
- Research proposals will be due by noon on Compass on the day scheduled for the course final, **Tuesday May 11th**
- There will be no final exam.

MSE 487 Course Schedule (Guest Lecture Dates subject to revision, may swap with Lectures)

Week 1

January 26: Lecture

January 28: Lecture

Week 2

February 2: Lecture

February 4: Lecture Homework 1 due *(Breakout paper 1 assigned)*

Week 3

February 9: Breakout groups Paper 1

February 11: Lecture; Homework 2 due *(Breakout paper 2 assigned)*

Week 4

February 16: Breakout groups Paper 2

February 18: Lecture; Critical Review 1 due

Week 5

February 23: Lecture

February 25: Guest Lecture 1; Assessments of Critical Review 1 due

Week 6

March 2: Breakout groups Guest Lecture 1

March 4: Lecture; Critical Review 2 due *(Breakout paper 3 assigned)*

Week 7

March 9: Breakout groups Paper 3

March 11: Guest Lecture 2; Assessments of Critical Review 2 due

Week 8

March 16: Breakout groups Guest Lecture 2

March 18: Lecture; Critical Review 3 due *(Breakout paper 4 assigned)*

Week 9

March 23: Breakout groups Paper 4

March 25: Guest Lecture 3; Assessments of Critical Review 3 due

Week 10

March 30: Breakout groups Guest Lecture 3

April 1: Lecture; Critical Review 4 due *(Breakout paper 5 assigned)*

Week 11

April 6: Breakout groups Paper 5

April 8: Guest Lecture 4; Assessments of Critical Review 4 due

Week 13

April 13: Non-Instruction Day

April 15: Lecture; Critical Review 5 due

Week 14

April 20: Breakout groups Guest Lecture 4

April 22: Guest Lecture 5; Assessments of Critical Review 5 due

Week 15

April 27: Breakout groups Guest Lecture 5

April 29: Student research proposal presentations

Week 16

May 4: Student research proposal presentations; Term papers due (accepted until May 11)

Week 17

May 11: Research proposals due

GRADING POLICY

All assignments due on Compass no later than 5 min. after the start of class. Assignments uploaded after this until noon the following day will receive 25 pts off. Assignments will not be accepted after that. If you have professional engagements (e.g. interviews) or significant personal issues (e.g. illness), contact Nathan and me via email for accommodations.

You are expected to have read the Student Code section related to Academic Integrity (http://admin.illinois.edu/policy/code/article1_part4_1-401.html). All infractions listed in the Student Code, including cheating and plagiarism, will result in penalties in accordance with the Student Code. If you have any question regarding what constitutes an infraction, contact me.

Plagiarism will be treated very seriously. If you do not understand what constitutes plagiarism, talk with me. For example, you cannot copy text from published papers without marking it as “copied from” or equivalent.

Paper selection for critical reviews

Each week a critical review is due, I will post in advance a list of ~450 papers published in Nature Nanotechnology and Nano Letters to compass2g (under “Course Content/Review Assignments. Each student will be assigned a number. You will pick one paper from the nine papers you are assigned, using the following formula:

Assigned paper #s = student number + 50n (n = integer from 0 to 8)

(e.g., if you are assigned student number #18, you pick one paper from paper #18, 68, 118, 168...)

Important: You should only pick original scientific articles, not commentaries or review articles. If in doubt, send me the pdf of the paper you select, and I will inform you if it is suitable.

Your review must be substantive. Follow the procedures indicated.