MEMS 1053: Structure of Crystals and Diffraction

Fall 2020

Instructor:	Shan Gong	**Time:**	Wednesdays 8:15am - 11:00am
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Office:	Rm 4-221		

Course Pages

- https://learn.scupi.cn

Office Hours

- Mondays & Tuesdays: 3:00PM – 5:00 PM
- By appointment via Email
- Online via QQ Group: 1130692671

Teaching Assistant

- Viola Chen
- Contact: 2017141522050@stu.scu.edu.cn
- If you have any question regarding to homework grading, please contact TA **within one week** after the homework is returned to you.

Course Description

Basic crystallography of materials; symmetry; point groups and space groups; tensor properties of crystals; diffraction methods in materials science; atomic packing and structures; glassy state, polycrystalline aggregates; grain boundaries and interfaces in materials; textures; multiphase materials; quantitative stereology and microstructural characterization. (3 credits)

Prerequisites

- Materials Structure and Properties (Or equivalent, or consent of instructor)
- MSE 1052–Manufacturing Processes and Analysis (recommended, not required)
- It is assumed that students have a basic knowledge of:
  - **Phase diagrams:** reading and understanding the diagrams, identifying phases and eutectics, solubility and relative composition of phases
  - **Basic kinetics:** equilibrium cooling (i.e., through a phase boundary) and time-temperature-transformation diagrams.
  - **Microstructure:** phases, eutectics, lamellae, connection to phase diagrams and kinetics.
- If these terms are fuzzy to you, review your course notes. Some of these concepts and phenomena will be briefly reviewed during class.

Course Objectives

After this course the students will be able to:

1. List the four states of matter and different structural states of condensed phases.
2. Discuss examples of how structure in addition to chemical composition of an engineered material affects properties and performance in applications.
3. Differentiate between long range and short range order as it relates to the description of the structure of materials.
4. Define the differences between non-crystalline and crystalline materials in terms of suitable descriptors.
5. List symmetry properties and use of them to describe structure of crystals.
6. List several basic descriptors suitable for discussion of the structure of materials.

Textbook

- M. De Graef and M.E. McHenry, "Structure of Materials", Cambridge University Press, 2nd edition (2012)

Reference Books

- C. Hammond, The Basics of Crystallography and Diffraction, Oxford University Press, 2nd edition (2000) and reprinted 2003.
- Kelly and G.W. Groves, Crystallography and Crystal Defects, Addison-Wesley (1970).
- Kelly, G.W. Groves and P. Kidd, Crystallography and Crystal Defects, John Wiley & Sons (2000).
- M.J. Buerger, Elementary Crystallography, Wiley (1963).
- B.D. Cullity, Elements of X-Ray Diffraction, Addison-Wesley (1978).
- B.D. Cullity and S.R. Stock, Elements of X-Ray Diffraction, 3rd Edition Prentice Hall (2001).
- K.J. Kurdzydlowski and B. Ralph, The Quantitative Description of the Microstructure of Materials, CRC (1995).
- D.M. Adams, Inorganic Solids, Wiley (1974).
- V. Randle, Microstructure Determination and its Applications, Inst. Of Materials, London (1992).
- V. Randle, The Role of Coincidence Site Lattice in Grain Boundary Engineering, Inst. Of Materials, London (1996).
- C.S. Barrett and T.B. Massalski, Structure of Metals, McGraw-Hill, 3rd ed. (1966).
- R. Tiley, Crystals and Crystal Structures, Wiley (2006).
- S.M. Allen and E.L. Thomas, "Structure of Materials", Wiley, 1999.

Assessments

Homework:	30%
Midterm Examination:	30%
Final Examination:	40%
	100%

Grade

Score	Letter Grade
90.00 – 100.00	A
85.00 – 89.99	A-
80.00 – 84.99	B+
76.00 – 79.99	B
73.00 – 75.99	B-
70.00 – 72.99	C+
66.00 – 69.99	C
63.00 – 65.99	C-
61.00 – 62.99	D+
60.00 – 60.99	D
0.00 – 59.99	F

Class Policy

- Regular attendance is essential and expected.
- Important dates and plans will be announced during class.

Homework and Other Assignments

Homework problems and other assignments will be assigned periodically and are due as stated. Late submission **WILL NOT** be accepted. Submissions must be done on **A4 papers** and **stapled** together at the top left-hand corner. **Students' names and ID numbers** must be listed on the first page.

Exams

There will be two exams (one Midterm and one Final), all are **CLOSED BOOK, CLOSED NOTES, CLOSED COMPUTER**. Students can bring **one** A4 page note and it must be **hand-written** on **two sides** of the paper. It cannot be a photocopy. If you must miss an exam, you **MUST** make alternative arrangements with the instructor before the exam is given. If you miss an exam without prior notification, you wil receive a score of **"ZERO"** for that exam except under extending circumstances.

Make-Up Exams

Students who have not taken either the midterm or the final exam are **NOT** eligible to take the make-up exam. Make-up exams can only be taken by students who have attained between 50% and 59.99% (out of 100%) of the total score. Only 75% of the make-up exam grade can be used to **replace** the final exam grade. Students taking make-up exams can only attain at most a **"D"** grade.

Avoiding Plagiarism

1. Unacknowledged direct copying from the work of another person,or the close paraphrasing of somebody else's work, is called plagiarism and is a serious offence, equated with cheating in examinations. This applies to copying both from other students' work and from published sources such as books, reports or journal articles.

2. Paraphrasing, when the original statement is still identifiable and has also no acknowledgement, is plagiarism. A close paraphrase of another person's work must have an acknowledgement to the source. It is not acceptable for you to put together Unacknowledged passages from the same or from different sources linking these together with a few words or sentences of your own and changing a few words from the original text: this is regarded as over-dependence on other sources, which is a form of plagiarism.