MSE 1053: Structure of Crystals and Diffraction
Fall 2023

Instructor

Dr. Liwei Geng
Zone 3-322B
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Meeting Time & Location

Monday 8:15-11:00 at RM 4-203

Office Hours

Tuesday & Thursday: 13:00-17:00, or by appointment

TA Information

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Course Catalog 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).

Course 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. (Key Reference)
- Kelly and G.W. Groves, Crystallography and Crystal Defects, Addison esley (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.

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Prerequisites

Materials Structure and Properties (Or equivalent, or consent of instructor)

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.

Topics Covered

1. Crystal structure
   - Two-dimensional symmetry and lattices
   - Bravais lattices and crystal system
2. Crystal symmetry
   - Symmetry operations
   - Point groups
   - Space groups
3. Lattice directions and planes
   - Miller indices, Miller-Bravais indices

- Zones axes

4. Reciprocal lattice
5. X-ray diffraction
- Diffraction geometry
- Diffraction intensities
- Diffraction of polycrystal

6. Electron diffraction

Grading

5%: participation (bonus)
30%: homework
35%: midterm exam
35%: final exam

Late Assignment Policy

10% deduction/day

Grade Policy

A: 90 – 100	A−: 85 – 89	B+: 80 – 84	B: 76 – 79	B−: 73 – 75
C+: 70 – 72	C: 66 – 69	C−: 63 – 65	D: 60 – 62	F: < 60

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Academic Integrity

All students are expected to adhere to the standards of academic honesty. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty would be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to the confiscation of the examination of any individual suspected of violating the University Policy.