



THE UNIVERSITY OF
NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

MATS 4023

PHASE TRANSFORMATIONS

Course Outline

Session 2, 2009

Course staff

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Lecturer &
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Consultation hours:
By appointment

Timetable

Lecture/Tutorial	Day	Time	Location
Lecture/Tutorial	Thursday	13:00 – 15:00	Australian School of Business 220 (K-E12-220)

Course Outline

WEEK	TOPIC*	DURATION
LIQUID-TO-SOLID		
#1	1. Introduction and brief overview of nucleation theory	2h
#2	2. Solidification of single-phase alloys – introduction	1h
	3. Theories of alloy growth – equilibrium & Scheil equations	1h
#3	4. Theories of alloy growth – diffusional mixing equation	1h
	5. Constitutional supercooling and interface stability	1h
#4	6. Single crystal growth – Bridgeman, Czokralski method etc.	1h
	7. Zone refining and production of semiconductors	1h
#5	8. Rapid solidification processing – glass formation	1h
	9. Crystallization of organic, inorganic and metallic glasses	1h
SOLID-STATE REACTIONS		
#6	10. Overview of nucleation and growth in the solid state	1h
	11. Interfaces and their role in phase transformations	1h
#7	12. Theories of particle coarsening and interface motion	2h
#8	13. Oswald ripening	2h
#9	14. Spinodal reactions	2h
#10	15. Martensite transformations in metals and ceramics	2h
#11	16. Shape memory effect in alloys	2h
#12	17. Summary of course	2h

* Topics will be covered on the prescribed week/s unless indicated otherwise

The learning and teaching philosophy underpinning the course (based on UNSW Learning Guidelines)

- Students are actively engaged in the learning process.
It is expected that, in addition to attending classes, students read, write, discuss, and are engaged in solving problems in phase transformations.
- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**
Problems involving *phase transformations* are challenging; students will be given assignments that will motivate deep analysis of various phenomena in materials science and engineering.
- **Learning is more effective when students’ prior experience and knowledge are recognised and built on.**
The course is built on prior courses in mathematics, mechanical behaviour, phase equilibria, crystallography and physical metallurgy.
- **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**
Students will be asked to analyse the role of phase transformations for understanding the relationship between microstructure and properties in engineering materials

Course information

Units of credit	3
Parallel teaching involved in this course	Nil
How the course relates to other course offerings and overall program(s) in the discipline	This course will give intellectual framework for a number of materials science courses such as phase equilibria, phase transformation, crystallography, mechanical behaviour, kinetics and diffusion, and others.
Course aims	The aim of this course is to further our understanding achieved in MATS4013 on the role of phase transformations on the development of microstructure and properties of metallic, ceramic and polymeric materials. The course will highlight a number of commercially-significant applications where phase transformations are important.
Graduate attributes which will be gained through the course	<ul style="list-style-type: none"> • Research, inquiry and analytical thinking abilities • Capability and motivation for intellectual development • Communication • Information literacy
Expected learning outcomes	<p><i>Students should gain:</i></p> <ul style="list-style-type: none"> • Enhanced critical thinking, analytical and problem solving skills in materials science and engineering. • An understanding of the principles underlying liquid-to-solid and solid-state phase transformations in a range of materials. • An understanding of the importance of phase transformations for controlling microstructure and properties in engineering alloys.

Teaching strategies	<ul style="list-style-type: none"> • Core concepts, theories and approaches to numerous problems concerning phase transformations will be covered in lectures. Examples will be provided to demonstrate these principles in materials science and engineering. Where appropriate, a number of tutorial classes will be conducted to enhance problem solving skills with incomplete problems given as home work. • It is expected that students attending classes are prepared for discussion. • Teaching material, including the course outline, assignments, examples of solutions of problems, and course announcements are available on the Course Vista website.
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Assessment	Assignments:	35%
	Final exam:	65%

Assignments will include three (3) problem sheets in order to achieve learning outcomes and develop graduate attributes.

Assignments*	Issue	Submission
Assignment 1	week 3	week 5
Assignment 2	week 6	week 8
Assignment 3	week 9	week 11

* Assignments will be issued when the class work is completed and not necessarily on the weeks noted above.

Note – All assignments must contain a completed student declaration sheet and will be due on the dates specified above. Assignments submitted after the deadline will receive a 10% of maximum grade penalty for every day late, or part thereof. Marked assignments will be returned within two weeks of submission. Requests seeking special consideration must be submitted using the form available from the Student Desk in the Chancellery and must include medical certificates or other appropriate documents.

Final exam – This major exam will cover all aspects of the course consisting of formal lectures, nominated reading material (from course handouts) and assignments. It will consist of a combination of essay-style answers and calculations. Any derivations will assume knowledge of the material rather than memorizing equations: relevant background equations will always be provided.

Recommended Reference Materials

- *Phase Transformations in Metals and Alloys*. D.A. Porter and K.E. Easterling, 2nd edition. Chapman & Hall (1992).
- *Physical Metallurgy Principles*: R.E. Reed-Hill and R. Abbaschian (1992).
- *Modern Physical Metallurgy*, R.E. Smallman (1985).
- *Light Alloys*: I.J. Polmear, 3rd edition. Edward Arnold (1995).
- *Steels – Microstructure and Properties*: R.W.K. Honeycombe and H.K.D.H. Bhadeshia, Edward Arnold (1995).

Continual Course Improvement

- In the latter stages of the course, students will be asked to provide evaluative feedback through UNSW's Course & Teaching Evaluation and Improvement (CATEI) Process. Feedback from prior evaluations will be discussed in the first lecture of the course.
- We welcome feedback at all times on presentation of course materials and any other course-related matters, and will be happy to discuss any issues raised in the lectures.
- Students are also encouraged to address any issues regarding teaching of this course at the annual staff-student meeting.

Administrative Matters

- Students must attend at least 80% of all classes.
- Students unable to attend the mid-session or final exam on the health grounds should make a request for special consideration by submitting the form available from the Student Desk in the Chancellery. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer.
- Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or www.equity.unsw.edu.au/disabil.html). Early notification is essential to enable any necessary adjustments to be made. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at:

www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf

Academic Honesty and Plagiarism

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
 - paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
 - piecing together sections of the work of others into a new whole;
 - presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
 - claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†
- For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.
 - Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.
 - Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.
 - The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.