



Aalto University
School of Engineering

COE-C2004 - Materials Science and Engineering

Exercise 5

Prof. Junhe Lian

Wenqi Liu, Rongfei Juan (Teaching assistant)

Outline

- Important updates
- Feedback on Assignment 4
- Feedback & Questions

Important updates

- **Computational training for week 4-6 will be optional.**
 - *Slides/Videos will be available online for self-learning.*
- **Lectures:**

<i>Week 6 (Dec 6 – 12)</i>	<ul style="list-style-type: none">• <i>L11-Dec 07: Physical properties of materials and sustainability</i>• <i>L12-Video: Review lecture</i>• <i>No lectures on Dec 6 & 10</i>• <i>Final Exercise/Q&A: Dec 9</i>
----------------------------	---
- **The grading weight of assignment will be accordingly modified.**
 - *A1-A3, 8 points*
 - *A4-A5, 5 points*
 - *A6, 6 points, opening on Dec 07.*
 - *In total, 40 points for 6 assignments. Your final grades will be accordingly updated in MyCourses system.*
- **Q/A session on Tuesdays will be merged with the exercise session on Thursdays.**
- **The case study has been opened in MyCourses.**
- **Exam (50 points): Written 70% + Oral 30%, more details will be given in E6.**

Review lecture

- Review lecture: L12-Video will be published in the last week.
- Address any questions from lectures / exercise / assignment / textbook on concepts / terms / equations / approaches / etc.
- Propose your questions here: www.menti.com, code: **78809152**, multiple submission is allowed.



Propose your questions here for MSE review lecture

Short answers are recommended. You have 250 characters left.

250

You can submit multiple answers

Submit

Assignment - General rules

Q&A

- Please avoid emails and use the “General discussion” on MyCourses!
- Please check the existing topics in “General discussion” before proposing a new one.
- Reply: Mondays, Tuesdays, Thursdays.
- Face-to-face Q&A time: Exercise session.

Timelines

- Open on MyCourses: every Monday before 18:00.
- Deadline: every Sunday at 18:00 to MyCourses.
- Cut-off deadline: every Tuesday at 16:00 to MyCourses.
- Solution open on MyCourses: every Tuesday at 16:30.
- For the last assignment (A6), no extension and later submission allowed, solution will be given on MyCourses before 18:30, 12.12.2021.

Assignment - General rules

Submission rules

- Only PDF type file is accepted for submission, please summarize all your answers/solutions in **one PDF file for every assignment**.
- Please name your assignment files with the assignment number and your first name and surname, and link them with short underlines: '**ANr_Firstname_Surname.pdf**', e.g. for the first Assignment 'A1_Wenqi_Liu.pdf'. It is appreciated to **sort the PDF pages in the TaskNr order**, which is helpful to speed up the evaluation process.
- **Clear handwriting, plotting, scanning with proper size are appreciated, especially in exams, otherwise, it might affect your scores.**
- Learning Group work is encouraged for this course. You could form a group with **max one additional peer** to review the lecture/exercise content and discuss the tasks in the assignment. After discussion, please **finish your assignment independently** and submit your individual report. Please note the **duplicate report is not accepted!** If you have a learning group, please **indicate who your group member is** in the submitted report. In addition, clearly state the individual contributions of each group member.

Assignment - General rules

- When required, always show the step-by-step derivation or calculation processes, without which hinting the number does not qualify for grades.
- When required, always give a brief and concise explanation or description, without which hinting the right choice or answer does not qualify for grades.
- **Citation is necessary** if you are using any figures/data that are not generated by yourself.
- Handwriting/plotting is acceptable, just **make sure that your handwriting/final photo in the system is clear enough, otherwise it may affect the grading for details/calculation process.**

Grades

- Delayed submission will be subjected to a penalty function in an exponential relation with time.
- Full points: 100 for every assignment, which will be calculated as 5-8 points in the final grade system. The weighted points will be indicated in each assignment. In total, 40 points for 6 assignments.
- Tolerant grading, **high points \neq exactly accurate answers!**
- **Check the assignment solution carefully!** This is the only standard answer (for calculations, equations, derivations, definitions) if there are similar questions in the exam.

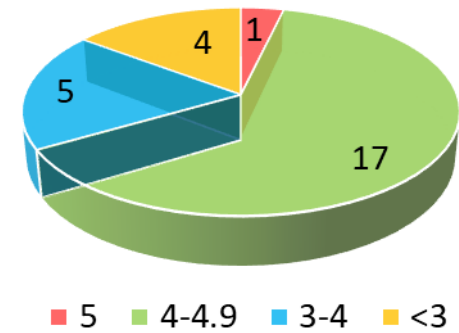
Assignment 04 - Summary

Submission: 27

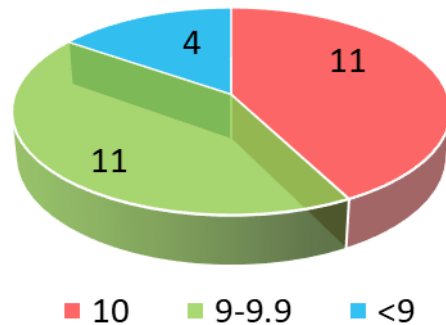
Full points: 100, is calculated as 5 points in the final grade system.

Due date: 18:00 PM, 28.11.2021 (Three delayed submission)

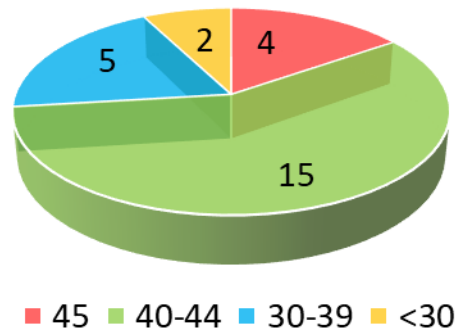
Summary



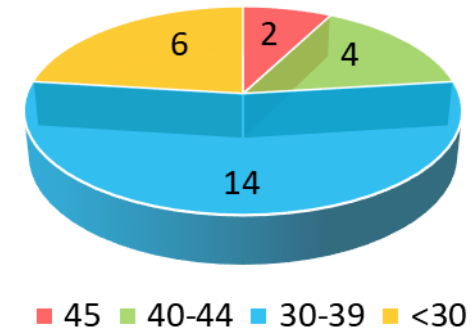
Task 1: 26, 10 points



Task 2: 26, 45 points



Task 3: 26, 45 points



Chemical composition

Chemical composition:

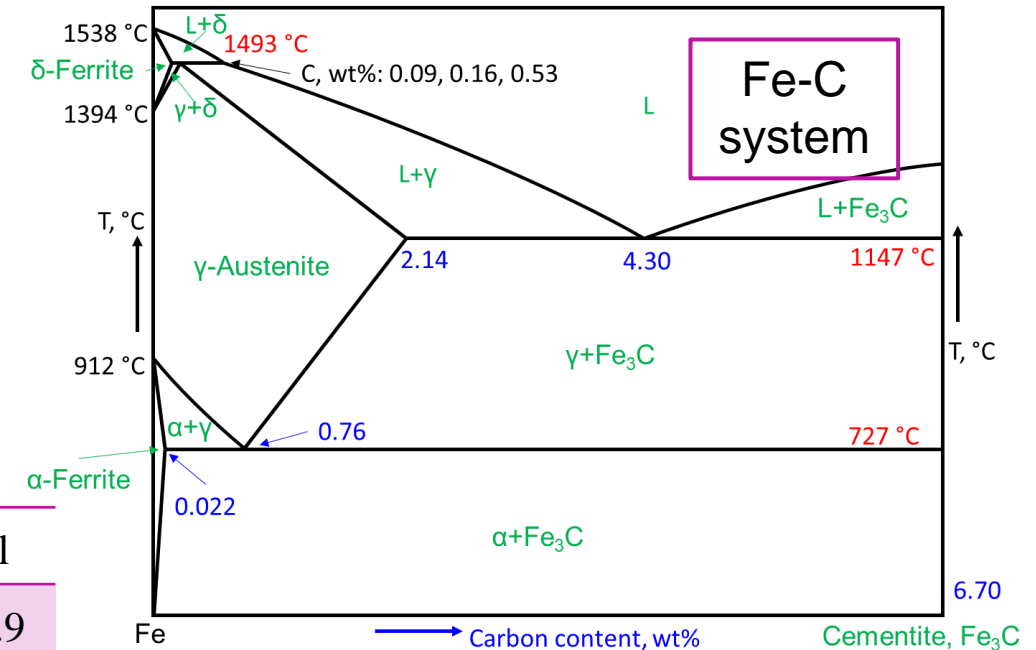
- the arrangement, type, and ratio of atoms in molecules of chemical substances.
- the distribution, content of the individual substances ("components") that constitute the mixture.
- the relative amount of all the elemental species present in a **material**, generally in weight/atom percent (wt% or at%), and can be measured by XRD/EDS/WDS/EPMA/APT/etc.

e.g.1: The compositions of Fe_3C and α -ferrite:

	C, wt%	Fe, wt%
α -ferrite	0.022	99.978
cementite	6.70	93.30

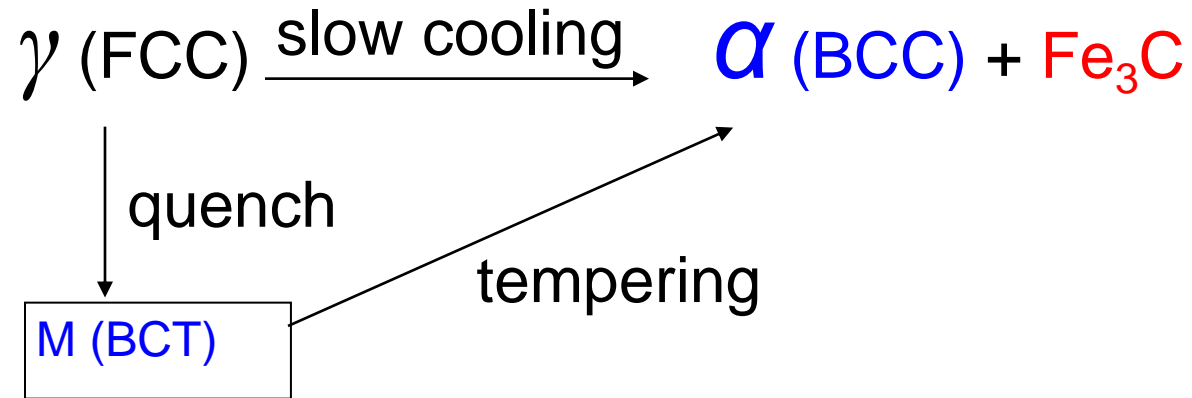
e.g.2: The compositions of an aluminum alloy 6061:

Element	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
wt%	0.607	0.120	0.183	0.084	0.972	0.077	0.004	0.029	97.9



https://www.researchgate.net/publication/320106777_Optimization_of_Machining_Parameters_in_Turning_of_Aluminium_Alloy_6061_Using_Taguchi_Method

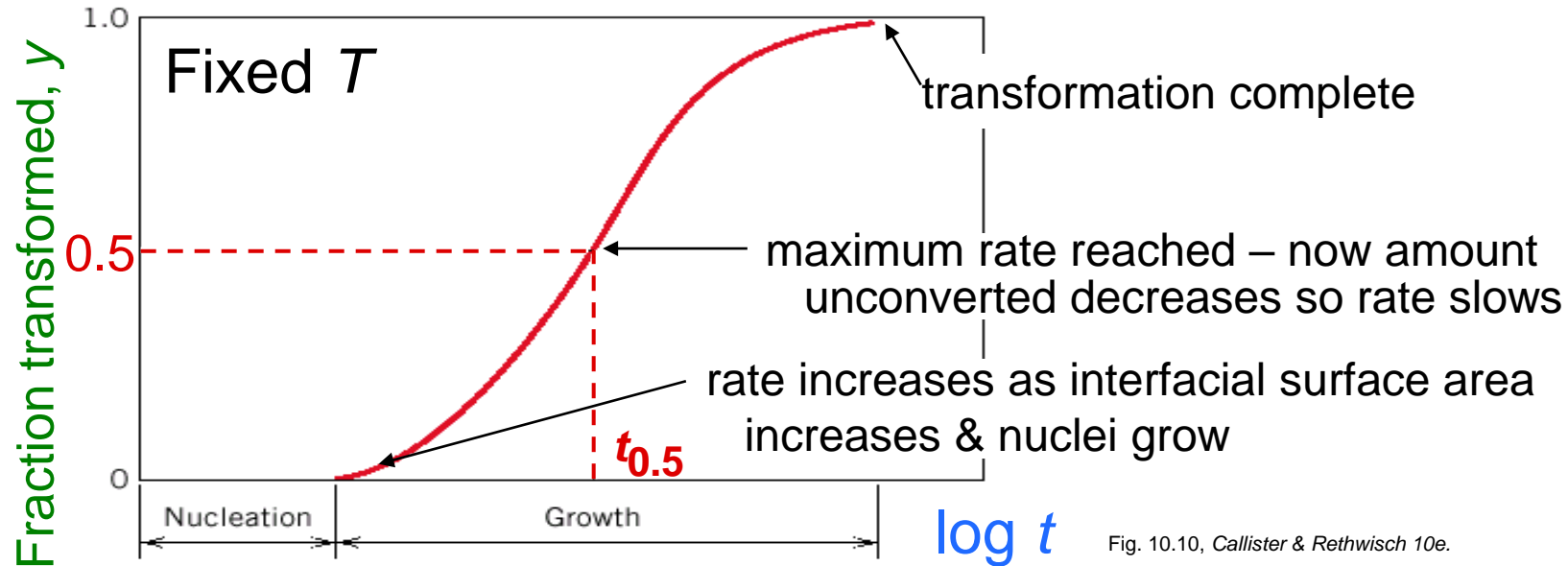
Martensite Formation



Martensite (M) -> High strength & Brittle

- Single phase with body centered tetragonal (BCT) structure
- Diffusionless transformation by shearing
- Increased dislocation density and residual stresses
- Fine microstructure
- Carbon solute solution/ Fe_3C during quenching

Rate of Phase Transformation



Avrami equation => $y = 1 - \exp(-kt^n)$

fraction transformed time

Also known as the
JMAK EQUATION

– k & n are parameters

By convention

$rate = 1 / t_{0.5}$

Case Studies

Case Study I - Microstructure modeling

- Analyze the microstructure information of the EBSD data and create an RVE.

Case Study II - Scientific article reading and summary

- Search articles online in the focused research fields of steel, read, and write an essay to summarize the articles.

Details in MyCourses - Case studies

- **Group work is allowed for Case Study 1.** You could form a group with **max. two additional peers** to solve the task and provide your solution. For the convenience of grading, still submit your report individually, but indicate who your group member is. In addition, clearly state the **individual contributions** of each group member.
- **Group work is not allowed for Case Study 2. Please finish this task independently and submit your own report.**
- Common due date: 18:00 PM, 19.12.2021
- Extra 5 points for each case study in the final grading system.
- *All information has been given in the task description files. As the additional case study to obtain extra points in the course, no more additional supports/resources would be given.*

Questions?

- **Assignment** submission DL is **18:00 on 05.12.2021**.
- Use the Zoom Chat function or raise your hands!
- Please avoid emails and use the “General discussion” on MyCourses!
- Please check the existing topics in “General discussion” before proposing a new one.