

COE-C2004 - Materials Science and Engineering
2021-2022 Autumn II

Assignment 5, 29.11.2021

General rules:

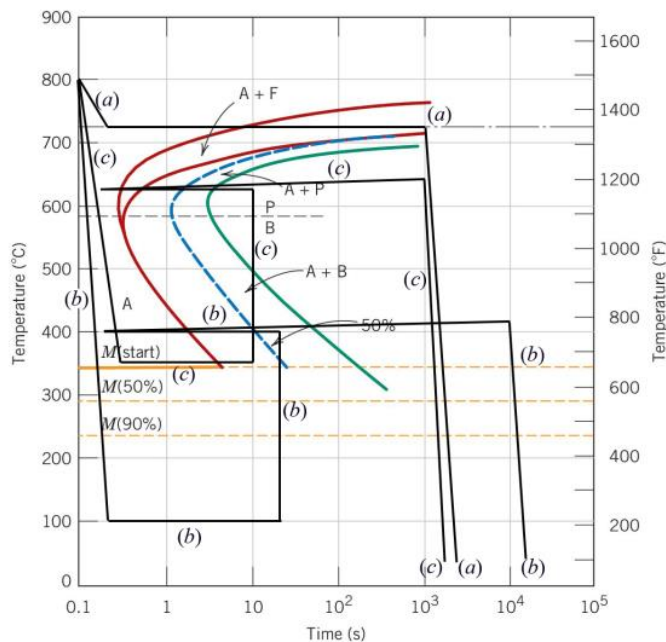
1. Learning Group work is encouraged for this course. You could form a group with max one additional peer to review the lecture/exercise content and discuss the tasks in the assignment. After discussion, please finish your assignment independently and submit your individual report. Please note the duplicate report is not accepted!
2. 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.
3. When required, always show the step-by-step derivation or calculation processes, without which hinting the number does not qualify for grades.
4. When required, always give a brief and concise explanation or description, without which hinting the right choice or answer does not qualify for grades.
5. Citation is necessary if you are using any figures/data that are not generated by yourself.
6. 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.
7. Only PDF type file is accepted for submission, please summarize all your answers/solutions in one PDF file for every assignment. It is appreciated to sort the PDF pages in the TaskNr order, which is helpful to speed up the evaluation process. 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'.
8. Assignment 5 will take 5 points in the final grade system.

Due date: 18:00, 05.12.2021.

Contact: MyCourses 'General discussion' channel

Task 1. Phase Transformation (15 points, Lecture9)

The following figure is the isothermal transformation diagram for a 0.45 wt% C iron-carbon alloy. List the microconstituent(s) present for the heat treatment labeled (a-c) on this diagram. Please explain your results.



[Reference: W. D. Callister and D. G. Rethwisch, Materials Science and Engineering: An Introduction, 8th Edition, Wiley, 2009.]

Task 2. Process (52 points, Lecture9)

2.1 Explain what casting is? List at least four types of casting methods with their frequently used mold materials, general process, and applications. And make a comparison between different types of casting methods, using either tables or plots. (Hint: you can explain with methods, usages, results, examples, etc.).

2.2 Explain annealing and its various types of applications. Compare the differences between full annealing with quenching and tempering in terms of processing parameters, resulting microstructure, and mechanical properties.

Task 3. Inorganic Non-metallic Materials (33 points, Lecture10)

3.1 True or False

- (1) For noncrystalline ceramics, plastic deformation occurs by the motion of dislocations.
- (2) The coordination number of ionic ceramics is constrained by the relative sizes of the compound's component species.
- (3) Consider the ZrO_2 crystal structure. The coordination number of Zr_{4+} ions is 8.
- (4) Na_2O , CaO , Al_2O_3 , and B_2O_3 are all oxides that may be found in silica-based glasses.
- (5) With increasing temperature, the following is the correct phase transformation sequence for a glass: supercooled liquid, solid, and liquid.
- (6) Consider the ideal barium titanate (BaTiO_3) structure, the coordination number of the Ba_{2+} ion in terms of surrounding Ti_{4+} ions is 8.

3.2 Name and plot seven kinds of ionic point defects that are found in ceramic compounds. (Please use figures and illustrations and make a proper citation of the figures if they are not created by you.)