MH2038 Micro and Nano Structures in Materials 6.0 credits

Mikro- och nanostrukturer i material

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for MH2038 valid from Autumn 2010

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Materials Science, Materials Science and Engineering

Specific prerequisites

MH1024 Fundamental Materials Science

MH1010 Basic thermodynamics

or equivalent

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After the course the student should be abel to:

- identify characteristic structure elements in micro- and nanostructures of crystalline materials and know how to analyze the most common structures in metallic and ceramic materials.
- interpret the microstructure of a material and by using phase diagrams be able to draw reasonable conclusions about how the material has been treated and which phase transformations that have occurred.
- explain and motivate which factors; composition, temperature cycle, deformation etc., that favour the formation of different structures.
- make reasonable assumptions of ternary phase diagrams based on information from binary phase diagrams.
- explain and motivate which fundamental chemical and physical quantities that are of importance for different types of phase transformations; diffusion, surface energy, coherency, thermodynamic driving force, thermal fluctuations etc.
- explain and schematically construct Gibbs energy diagrams and explain the geometrical significance of e.g. driving force for the initial precipitation of one phase from another, the effect of surface energy on a two phase equilibria.
- calculate e.g. driving force for the initial precipitation, critical radius for nucleation, growth rates, segregation during solidification, grain growth, rate of phase transformation and combine these to solve more complex problems using reasonable assumptions.
- apply TTT and CCT diagrams to analyse what takes place in a material during e.g. heat treatment and also be able to motivate how these diagrams are affected by thermodynamic and microstructural factors.
- explain the thermodynamic and kinetic factors that favours amorphous materials.

Course contents

The course covers fundamental theory of phase transformations, fundamental thermodynamics of phase diagrams and application of binary and ternary phase diagrams, formation of micro- and nanostructures through nucleation and growth, crystalline and amorphous solidification, transformations in solid phases, relaxation phenomena, equilibrium and transformations in metallic and ceramic materials.

Disposition

Lectures, tutorials and laborations, see the course schedule

Course literature

D.A. Porter and K.E. Easterling, Phase transformations in Metals and Alloys

Metallographic atlas

Examination

- INL1 - Assignments, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 3.5 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory Work, 1.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

Laboratory work, assignments, and written examination

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.