

MSE-204

Thermodynamics for materials science

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Cursus	Sem.	Type
Materials Science and Engineering	BA3	Obl.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	3 weekly
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This lecture establishes the basic concepts of thermodynamics and defines the main state functions. The concepts are then applied to the study of phase transformations and to establish the phase diagram of mixtures.

Content

1. Reminder of basic thermodynamics. Introduction to state functions and fundamental equations. Chemical potential.
2. Treatment of mixtures. Molar and partial molar variables.
3. General treatment of chemical reactions. Reaction progress. Variables of reaction (enthalpy, entropy, free energy of reaction). Standard state. Heats of reaction and formation of chemical substances.
4. Chemical reactions in the gaseous state. Law of mass action. Equilibrium constant. Kirchoff's rule. Van't Hoff's equation.
5. Phase equilibria of mixtures. Gibbs' rule of phases.
6. Chemical reactions in solutions. Equilibrium constant. Effects of pressure and temperature. The case of corrosion and batteries.
7. Ideal solutions. Chemical potential. Osmotic pressure, the case of membranes. Melting and boiling points. Eutectic point.
8. Non-ideal solutions. Standard states. Chemical potentials. Activity coefficients.
9. Phase diagrams. Excess variables of mixing.
10. Thermodynamic treatment of batteries and fuel cells.

Learning Prerequisites**Recommended courses**

Various courses of the Materials science and engineering section

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze a thermodynamics problem
- Compute the changes in entropy, enthalpy and Gibbs free energy
- Construct a phase diagram
- Interpret the chemical potential

Teaching methods

Ex cathedra et exercises

Resources

Ressources en bibliothèque

- [The bases of chemical thermodynamics I / Grätzel](#)
- [The bases of chemical thermodynamics II / Grätzel](#)
- [Thermodynamique : principes et applications \(français\)](#)