PHYS-307

Physics of materials

Mari Daniele

Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course illustrates some selected chapters of materials physics needed to understand the mechanical and structural properties of solids. This course deals in particular with the physics of dislocation. The diffusion and phase transformations are complementary bases.

Content

1. Materials, definitions, structure
Binding energy in metals, ceramics and polymers. Crystal structure and amorphous materials. Theory of elasticity: stress and strain fields.
2. Diffusion
Diffusion in alloys. Physical and chemical diffusion.
3. Plastic deformation and dislocations
Phenomenology. Deformation of single crystals. Burgers' vector. Elasticity theory: interactions among dislocations. Creation and annihilation of dislocations.
4. Dislocation dynamics
Friction forces due to the lattice, to point defects and to dislocations. Movement equations. Partial dislocations and stacking faults. Dissociation mechanisms: dislocations in face centred cubic metals.
5. Dislocation kinetics
Thermal activation of plastic deformation. Dislocation climb. Deformation tests. Relaxation phenomena and mechanical spectroscopy.
6. Thermodynamics of phase transformations
Thermodynamical principles of phase transformations.Phase diagrams. Alloy solidification. Solid-solid phase transformations.

Keywords

dislocations, deformation, diffusion, elasticity, phase transformations, melting, precipitation crystallography

Learning Prerequisites

Recommended courses

linear algebra I,II
analysis III, IV
physics I,II

Learning Outcomes

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

- Develop the formalism of dislocation theory
- Model the plastic deformation of materials
- Sketch a phase diagram and its thermodynamic basis

Transversal skills

- Use a work methodology appropriate to the task.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.

Teaching methods

Ex cathedra with exercises in the classroom

Assessment methods

Oral exam in French or English

Prerequisite for

Physics of new materials