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Fakultät für Naturwissenschaften, Fachbereich Physik

Announcement

Crystal Defects: Physical Effects and Mechanics

Apl. Prof. Dr. Jeong-Ha You

Learning outcomes

The students who have successfully completed the course work of this lecture will

- gain basic understanding on the types, structures, formation mechanisms and physical effects of various kinds of crystal defects,
- be equipped with theoretical skills for describing the dynamic interactions and energetic reactions between defects based on a continuum mechanics framework,
- be able to interpret various physical, thermal and mechanical features being observed in actual crystalline solids in terms of defect effects in addition to idealized bulk behaviours,
- get fundamental knowledge on the microstructures and mechanical behaviours of engineering materials.

Content

- Classification and structures of crystal defects
- Point defects: formation mechanisms, physical effects, thermodynamics, irradiation damage
- Elements of solid mechanics (linear elastic), continuum slip theory, crystal plasticity
- Line defects: edge/screw dislocation, slip mechanisms, stress/displacement/strain fields
- Dynamics of dislocations: line tension, forces between dislocations, reaction mechanisms
- Planar defects: structure of grain boundaries, impact on mechanical behaviour, interactions
- Recovery of defects, recrystalization and grain growth

Prerequisites

Introductory courses on calculus, mechanics and solid state physics (or materials science)

Additional information

Course type: Lecture
Attendance time: Block lecture (6 modules each consisting of 4 class hours)
3 ECTS credits
Individual project report

Date

Begin: January (Lecture dates according to prior agreement)
First meeting for orientation: will be announced later

Instructor

PD Dr.Jeong-Ha You, Max Planck Institute for Plasma Physics (you@ipp.mpg.de)

Literature

Introduction to dislocations (D. Hull, D.J. Bacon)
Physikalische Grundlagen der Materialkunde (G. Gottstein)
Mechanical behaviour of materials (K. Bowman)
Physical Metallurgy Principles (R.E. Reed-Hill)
Physical Metallurgy I, II (R.W. Cahn, P. Haasen)
Theory of dislocations (J.P. Hirth)
Crystals, defects and microstructure (R. Phillips)