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Universität Ulm

Master of Science Physics (PO 2017)

Crystal Defects: Physical Effects and Mechanics

Code	8812872189
ECTS credits	3
Attendance time	2
Language of instruction	English
Duration	1 Semester
Cycle	irregular
Coordinator	Dean of Physics studies
Instructor(s)	Prof. Jeong-Ha You, Max Planck Institute for Plasma Physics, Garching
Allocation of study programmes	Physics M.Sc., elective module, 1st or 2nd semester Advanced Materials M.Sc., compulsory elective module, 1.-3. semester
Recommended prerequisites	Introductory courses in calculus, mechanics and solid state physics
Learning objectives	Students who successfully pass this module • gain basic understanding on the types, structures, formation mechanisms and physical effects of various kind of crystal defects • are equipped with theoretical skills for describing the dynamic interactions and energetic reactions between defects based on a continuum mechanics framework • are 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 • gain fundamental knowledge on the microstructures and mechanical behaviours of engineering materials
Syllabus	• 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 dislocation: line tension, forces between dislocations, reaction mechanisms
- Planar defects: structure of grain bundaries, impact on mechanical behaviour, interactions
- Recovery of defects, recrystallization and grain growth

Literature

- Mechanical Behaviour of Materials, Keith Bowman, John Wiley & Sons, 2004
- Physikalische Grundlagen der Materialkunde, G. Gottstein, Springer-Lehrbuch (3 Aufl.), Springer
- Introduction to Dislocations, Hull & Bacon, Pergamon (3rd Ed.)
- Deformation and Fracture Mechanics of Engineering Materials, R. Hertzberg, John Wiley & Sons
- Theory of Dislocations, Hirth & Lothe, John Wiley & Sons
- Crystal Defects and Microstructures, R.Phillips, Cambridge University Press
- Crystallography and Crystal Defects (revised ed.), A. Kelly, G. W. Groves, P. Kidd, John Wiley & Sons
- Mechanical Metallurgy, M. Meyers, K. Chawla, Prentice Hall

Teaching and learning methods

Course type: block lecture

For example: Monday-Thursday, 12:30-18:00

Workload

22 hours lecture (attendance time)

23 hours exercise (attendance time)

45 hours self-study and exam preparation

Total: 90 hours

Assessment

The grade of the module will be the grade of the oral or written (depending on the number of participants) exam. No prerequisites are necessary for exam registration.

Grading procedure

The grade of the module will be the grade of the exam.

Basis for

Research in the field of Condensed Matter