UNIVERSITEIT GENT

Studiefiche

Vanaf academiejaar 2024-2025

Fysische materiaalkunde (E066170)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 6.0 **Studietijd 180 u**

Aanbodsessies in academiejaar 2025-2026

B (semester 1)	Nederlands	Gent
C (semester 1)	Engels	Gent

Lesgevers in academiejaar 2025-2026

Kestens, Leo	TW08	Verantwoordelijk lesgever

Aangeboden in onderstaande opleidingen in 2025-2026	**stptn**	**aanbodsessie**
Brugprogramma Master of Science in Sustainable Materials Engineering	6	C
European Master of Science in Nuclear Fusion and Engineering Physics	6	C
Master of Science in de ingenieurswetenschappen: materiaalkunde	6	B
Master of Science in Photonics Engineering	6	C
Master of Science in Sustainable Materials Engineering	6	C

Onderwijstalen

Engels, Nederlands

Trefwoorden

Physical materials science, polycrystalline materials, interface migration, deformed state, solid state transformations, recrystallization, grain growth, martensite transformations

Situering

To provide basic knowledge and insight in the principles of materials science, discussion of the microstructure of polycrystalline materials and the solid-state transformations by which the microstructures are formed and controlled. Scientific knowledge on the mechanisms that produce different microstructures and the influence thereof on properties.

Inhoud

1 Crystallography of polycrystaline materials: representation of single orientations, representation of textures, orientation density functions, crystallography of grain boundaries, aspects of crystal and sample symmetry;

2 Interfaces: Classification, geometry and energy of interfaces (small vs large angle boundaries, tilt vs twist boundaries, coherent vs incoherent interfaces), surface tension, equilibrium shape of surfaces, presence of a 2nd phase, shape of grains in 2D and 3D, grain-boundary segregation, motion of grain boundaries (driving force and mobility);

3 Precipitation from solid solutions: Review of free-energy composition diagrams (the tangent rule, spinodal points), crystallographic description of precipitation, precipitation sequence, kinetics of precipitation reactions (initial formation, particle coarsening, precipitation hardening, examples;

4 The deformed state of polycrystalline materials: the stored energy of cold work, cell-forming and non-cell forming metals, strain heterogeneities: deformation and shear bands, transition bands, deformation textures;

5 Recrystalliization and grain growth: release of stored energy during annealing, property changes, recovery mechanisms (subgrain growth, coalescence, polygonization), kinetics of recovery, nucleation mechanisms for recrystallization, kinetics of recrystallization (JMAK theory, experimental validation, effect of strain, temperature, purity and grain size), control of recrystallization temperature and grain size, dynamic recrystallization, normal grain growth (parabolic law of GG), grain growth in the presence of 2nd phase particles (Zener pinning theory), abnormal grain growth (secondary recrystallization, recrystallization and gran growth textures;

6 Order-disorder structures: Study of order-disorder structures in material systems;

7 Martensitic transformations: twinning (phenomenological and crystallographic aspects of deformation and annealing twins), invariant plane strain transformations, crystallography of martensitic (displacive) transformations, characteristics of martensitic transformations (cooperative motion, interface velocity, diffusionless character, morphology, interface structure, kinetics), thermo-elastic martensites, the shape-memory effect, bainite (basic characteristics, crystallography, reaction mechanisms);

Begincompetenties

Microstructurele opbouw van de materialen (E066020)

Eindcompetenties

1 Kennis verwerven omtrent de kristallografische structuur en eigenschappen van (mechanische) tweelingen.
2 Fysisch inzicht verwerven in de structuur en eigenschappen van grensvlakken.
3 Het kunnen leggen van een verband tussen de typische kenmerken van de (sub-)structuur van een plastisch vervormd metaal en de eigenschappen van de gerekristalliseerde structuur na herstelgloeien.
4 Inzicht verwerven in het proces van de martensitische fazentransformatie.
5 Het beheersen van de basisbegrippen uit de kwantitatieve textuuranalyse.
6 Een verdiept inzicht verwerven in de relatie tussen thermodynamische wetmatigheden en de vorming van microstructuren in materialen.
7 Beheersen en kunnen toepassen van de basisbegrippen uit de materiaalkunde-kristallografie.

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Werkcollege, Hoorcollege, Zelfstandig werk

Toelichtingen bij de didactische werkvormen

Ex-cathedra lectures added with classroom exercises and homeworks.

Studiemateriaal

Geen

Referenties

- D.A. Porter and K.E. Easterling: Phase Transformations in Metals and Alloys, Stanley Thornes (Publishers) Ltd, Cheltenham, UK, 2000
- John D. Verhoeven, Fundamentals of Physical Metallurgy, 1975, Wiley, ISBN 0-471-616-6
- F.J. Humphreys and M. Hatherly, Recrystallization and Related Annealing Phenomena, Elsevier, 2004 (2nd edition), ISBN 0 08 044164 5

Vakinhoudelijke studiebegeleiding

Evaluatiemomenten

periodegebonden en niet-periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Mondelinge evaluatie

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Mondelinge evaluatie

Evaluatievormen bij niet-periodegebonden evaluatie

Participatie, Werkstuk

Tweede examenkans in geval van niet-periodegebonden evaluatie

Examen in de tweede examenperiode is mogelijk

Toelichtingen bij de evaluatievormen

During examination period: oral closed-book exam, written preparation.
Theory and applications will be evaluated separately.
During semester: graded exercises of homework assignments.

Eindscoreberekening

60% of evaluation on knowledge of classroom taught material ("theory") and 40% of evaluation on assignments (exercises). Marks of 1st examination period can be transferred to 2nd examination period.