Modul Fundamental Aspects of Materials Science and Microengineering

Fundamental Aspects of Materials Science and Microengineering

Version 1 (seit SS16) Modulverantwortliche/r: Prof. Dr.-Ing. Gunther Eggeler	6 LP / 180 h

Lernziele/Kompetenzen:
The most important materials science concepts will be reviewed. Emphasis is placed on the importance of the strong link between elementary atomistic, crystallographic, thermodynamic/kinetic and microstructural processes and the behavior of materials/ components on the macro scale. Students learn how to apply basic concepts in modern materials engineering. They understand how new materials are developed and how state of the art materials can be further improved. The students are trained to assess the mechanical and functional properties of materials and to understand kinetic processes in and at solids. Important aspects of how to read and use ternary phase diagrams will be taught. Special emphasis is placed on alloys and compounds in multinary systems (e.g. intermetallic phases, oxides, nitrides, …). The students apply this knowledge when they about the combinatorial materials research approach for the discovery of new materials. The students will learn to apply materials science theory to four fascinating material classes: high entropy alloys (HEAs), intermetallic phases (IPs), single crystal Ni-base superalloys (SX) and shape memory alloys (SMAs). The HEA topic allows to develop a deeper knowledge about the physical nature of solid solutions. IPs provide the opportunity to strengthen the knowledge about crystallographic concepts and to appreciate ordering processes in crystal lattices. Together with an introduction to SX (application, processing, metallurgy, strength) the students will acquire knowledge about high temperature strength and diffusion controlled deformation processes. Together with a good understanding of SMAs (systems, processing, functional properties, one way effect, pseudoelasticity) the students will acquire a good understanding of atomistic, mesoscopic and macroscopic aspects of the diffusionless martensitic transformation, which also governs the hardening of steels.

Lehrveranstaltungen

Fundamental Aspects of Materials Science and Microengineering **Lehrformen:** Vorlesung (3 SWS), Übung (1 SWS) **Lehrende:** Prof. Dr.-Ing. Gunther Eggeler, Prof. Dr.-Ing. Alfred Ludwig **Sprache:** Englisch **Häufigkeit des Angebots:** jedes Sommersemester	4 SWS

Inhalte:

• Importance of atoms and electrons in materials engineering and the transition from atoms to alloys and from alloys to components

• Thermodynamic concepts in materials engineering and fundamentals of alloy design (with a special focus on ternary phase diagrams)

• Kinetic concepts in materials science and engineering (with a focus on microstructural evolution)

• Basic concepts of solid state phase transformations • Understanding and application of knowledge to four materials classes: high entropy alloys, intermetallic phases, single crystal superalloys and shape memory alloys • Acquisition of knowledge about high temperature strength (example: superalloys), fracture mechanics and fatigue (example: shape memory alloys), structure and properties of alloys and compounds (chemistry, crystallography and physical properties) and methods for the invention of new materials **Arbeitsaufwände:** - Präsenzzeit: 60 h Präsenzstudium - Vor und Nachbereitung (einschl. Prüfung): 120 h Eigenstudium **Medienformen:** Projektor und Tafel **Literatur:** Vorlesungsbegleitende Literatur wird bekannt gegeben.	

Prüfung : Klausur Klausur / 120 Minuten , Anteil der Modulnote : 100 %