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**Modulbezeichnung:** Transmission Electron Microscopy in Material Science I (IMN\_M10/11-MWT\_TEMI) (Transmission Electron Microscopy in Material Science I) **5 ECTS**

Modulverantwortliche/r: Erdmann Spiecker

Lehrende: Johannes Will, Stefanie Rechberger, Erdmann Spiecker, Benjamin Apeleo-Zubiri, Mingjian Wu

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Startsemester: WS 2022/2023

Dauer: 1 Semester

Turnus: jährlich (WS)

Präsenzzeit: 60 Std.

Eigenstudium: 90 Std.

Sprache: Deutsch und Englisch

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### Lehrveranstaltungen:

Transmissionselektronenmikroskopie in Materialforschung und Nanotechnologie 1 (WS 2022/2023, Vorlesung, 2 SWS, Erdmann Spiecker)

Übungen zur Transmissionselektronenmikroskopie 1 (WS 2022/2023, Übung, 2 SWS, Mingjian Wu et al.)

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### Inhalt:

The module deals with the fundamentals of micro- and nanostructure research with the focus on today's state-of-the-art capabilities of transmission electron microscopy in the investigation of materials down to the atomic scale. The module begins with the basic physics of fast electrons, their generation and guidance by electromagnetic fields and their interaction with matter in the specimen and the detector. Afterwards conventional imaging (BF, DF) and diffraction (ED, CBED) techniques including their applications to current research topics will be introduced. The aim is always to give insight into both the contrast mechanisms and physics of as well as the achievable information delivered by the different techniques. This module can only be chosen as "Wahlmodul" and not in combination with "Kernfachmodule WW9" ("Fundamentals of Micro- and Nanostructure Research" & "Applied Micro- and Nanostructure Research").

### Lernziele und Kompetenzen:

Die Studierenden

*Fachkompetenz*

*Wissen*

- Basic concepts of the interaction of fast electrons with matter
- Introduction of TEM components and their functionality

*Verstehen*

- In-depth understanding of microscopy techniques for micro- and nanostructure research
- In-depth understanding of basic imaging and diffraction TEM techniques and their application to material science
- Insight into the structure property relationship of materials

*Anwenden*

- Hands-on-training on modern analysis software for EM applications
- Hands-on-training and experience on transmission electron microscopes accompanied with suitable exercises (3 days of practical exercise "as block" during the first week of the semester break in February)

### Literatur:

- Goodhews, Humphreys and Beanland: Electron Microscopy and Analysis
- Williams & Carter: Transmission Electron Microscopy
- Reimer & Kohl: Transmission Electron Microscopy
- Fultz & Howe: Transmission Electron Microscopy and Diffractometry of Materials
- Reimer: Transmission Electron Microscopy
- De Graef: Introduction to Conventional Transmission Electron Microscopy
- P. Haasen: Physikalische Metallkunde
- G. Gottstein: Physikalische Grundlagen der Materialkunde
- J. M. Cowley: Diffraction Physics

- Lecture notes.

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**Studien-/Prüfungsleistungen:**

Transmission Electron Microscopy in Material Science I (Prüfungsnummer: 62861)

(englische Bezeichnung: Transmission Electron Microscopy in Material Science I)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 15

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

Prüfungssprache nach Wahl der Studierenden

Prüfungssprache: Deutsch oder Englisch

Erstablingung: WS 2022/2023, 1. Wdh.: SS 2023

1. Prüfer: Erdmann Spiecker

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