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**Modulbezeichnung:** Fundamentals of Micro- and Nanostructure Research 10 ECTS  
 MWT (IMN\_M1/6/8-MWT)  
 (Fundamentals of Micro- and Nanostructure Research MWT)

Modulverantwortliche/r: Erdmann Spiecker

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

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Startsemester: WS 2021/2022

Dauer: 2 semester

Turnus: jährlich (WS)

Präsenzzeit: 120 Std.

Eigenstudium: 180 Std.

Sprache: Deutsch und Englisch

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### Lehrveranstaltungen:

Transmissionselektronenmikroskopie in Materialforschung und Nanotechnologie 1 (WS 2021/2022, Vorlesung, 2 SWS, Erdmann Spiecker)

Übungen zur Transmissionselektronenmikroskopie 1 (WS 2021/2022, Übung, 2 SWS, Mingjian Wu et al.)

Transmissionselektronenmikroskopie in Materialforschung und Nanotechnologie 2 (SS 2022, Vorlesung, 2 SWS, Erdmann Spiecker et al.)

Übungen zur Transmissionselektronenmikroskopie 2 (SS 2022, 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 various imaging (BF, DF, HRTEM, STEM), diffraction (ED, CBED), spectroscopic (EDXS, EELS, EFTEM) and 3D (ET) 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.

### Lernziele und Kompetenzen:

Die Studierenden

*Fachkompetenz*

*Wissen*

- Basic concepts of the interaction of fast electrons with matter
- Introduction of TEM components and their functionality
- Knowledge about the application of high resolution techniques for nanomaterials

*Verstehen*

- In-depth understanding of microscopy techniques for micro- and nanostructure research
- In-depth understanding of basic and advanced imaging, diffraction and spectroscopic TEM techniques and their application to material science

*Anwenden*

- Hands-on-training on modern analysis software for EM applications
- Each topic will be accompanied with suitable exercises

*Analysieren*

- Insight into the structure property relationship of materials

### 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; Reimer: Scanning Electron Microscopy; P. Haasen: Physikalische Metallkunde; G. Gottstein: Physikalische Grundlagen der Materialkunde; J. M. Cowley: Diffraction Physics

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### Studien-/Prüfungsleistungen:

Fundamentals of Micro- and Nanostructure Research (Prüfungsnummer: 62811)

(englische Bezeichnung: Fundamentals of Micro- and Nanostructure Research)

Untertitel: MWT Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 30

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

Prüfungssprache nach Wahl der Studierenden

Prüfungssprache: Deutsch oder Englisch

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

1. Prüfer: Erdmann Spiecker

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