

## **Materials for Quantum Nanotechnologies and Nano-Analytical Methods**

SS 2020, Ursula Wurstbauer (<https://www.uni-muenster.de/Physik.PI/Wurstbauer/teaching/teaching.html>)

### **Vorbesprechung und Einführung / Introduction**

\*\* english below \*\*

Liebe Studierende,

die Vorbesprechung zur Durchführung und den organisatorischen Details als auch eine Einführung und Motivation zu den Inhalten des Kurses "Materialien für Quanten-Nanotechnologien und Nanoanalytische Methoden"

findet am Donnerstag, 23.04.2020 um 10:00 in unten angegeben Zoom-Meeting Room statt.

Die VL soll (zunächst) mittels Zoom durchgeführt werden, so dass eine aktive Beteiligung möglich und auch erwünscht ist. Die Vorlesungsunterlagen werden vorab mittels Learnweb zur Verfügung gestellt. Die Materialien werden in englischer Sprache verfasst sein, die Vorlesungssprache ist je nach Wunsch der Teilnehmer\*innen englisch oder deutsch. Weitere Informationen zu Organisation und Inhalt sind unten angefügt.

Ich freue mich auf Sie und den Start des Semesters.

Beste Grüße,

Ursula Wurstbauer

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*Dear All,*

*the introduction to the lecture "materials for quantum-nano technologies and nano-analytical methods" will take place on*

*Thursday, 23.04.2020 at 10:00 in the Zoom-Meeting Room given below.*

*The lecture will start via Zoom such that you can actively participate. The related materials and content will be provided prior to each lecture on Learnweb. The materials are provided in English and the language of the actual lectures are either English or German given according to the request of the participants. For further information to organization and content please see below.*

*I am looking forward meeting you next week!*

*Best regards,*

*Ursula Wurstbauer*

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### **Basic facts:**

- Thursdays: 10:00-11:30, first lecture on 23. April
- 2 SWS
- Language: English
- Video-lecture using Zoom (entry information on learnweb and below)
- Materials: lecture slides will be provided before the lecture on learnweb (MFQUNM-2020\_1)
- Literature: Research related literature provided in the lecture and advanced solid-state text-books, e.g.
  - Rudolf Gross und Achim Marx, Festkörperphysik De Gruyter Oldenbourg, 2014  
doi:10.1524/9783110358704 (sorry, only in german)
  - Peter YU, Manuel Cardona, Fundamentals of Semiconductors, Springer Berlin, 2016, ISBN 978-3-642-00710-1 (excellent book, but I recommend to us it together with a standard solid-state textbook)
    - *Both books are available as e-book at the WWU library*
- Active participation via discussion and quiz

### **Content:**

In this lecture we will discuss solid state-based quantum materials, materials and concepts for quantum technological applications as well as selected nano-analytical methodologies applied to quantum materials. The lecture covers advanced solid-state physics topics as well as modern concepts for quantum technology such as:

- Introduction to quantum materials and materials for quantum technology including emergent functionality due to interaction physics (examples are superconductivity, Bose-Einstein condensation that also happens in ensembles of atoms)
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- Electronic properties of (quasi) 0D, 1D and 2D solid state systems
- Overview of major methods to create quantum materials and materials for quantum-technologies:
  - a) *creation by quantum confinement*
  - b) *creation by local electrostatic confinement (local gates)*
  - c) *by geometry*
  - d) *crystal growth e.g. by molecular epitaxy*-> The concepts as well as suitable nano-analytical methods are elaborated
- Transport phenomena in 0D, 1D and 2D systems:
  - a) Transport through a 0D quantum state: Coulomb Blockade and Coulomb Diamonds
  - b) Quantized conductance through 1D wires
  - c) Weak localization and quantum interference phenomena
  - d) Classical and Quantum Hall Effect in 2D
  - e) Optional: Introduction to (non-abelian) Fractional Quantum Hall effect states
- Optical properties with a focus on 0D systems:
  - a) Optical interband transitions
  - b) Excitons
  - c) Single photon emitter and their experimental proof by anti-bunching experiments

### **Preconditions**

There are no access requirements beyond the ones for the master study as in particular basic knowledge in solid-state physics and quantum mechanics.

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Ursula Wurstbauer lädt Sie zu einem geplanten Zoom-Meeting ein.

Thema: Vorbesprechung VL MFQUNM-2020\_1 (110027)

Uhrzeit: 23.Apr.2020 10:15 AM Paris

Zoom-Meeting beitreten

<https://www.zoom.us/j/9902869957>

Meeting-ID: 990 286 9957

Schnelleinwahl mobil

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Meeting-ID: 990 286 9957

Ortseinwahl suchen: <https://www.zoom.us/j/9902869957>