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| <b>Modulbezeichnung:</b> Physical chemistry (MSM-ME3)<br>(Physical chemistry)                                                       | <b>15 ECTS</b>               |
| Modulverantwortliche/r: Rainer Fink                                                                                                 |                              |
| Lehrende: Dirk Guldi, Jörg Libuda, Guido Sauer, Thomas Drewello, Rainer Fink, Franziska Gröhn, Christian Papp, u.a., Carola Kryschi |                              |
| Startsemester: WS 2018/2019                                                                                                         | Dauer: 2 semester            |
| Präsenzzeit: 210 Std.                                                                                                               | Eigenstudium: 240 Std.       |
|                                                                                                                                     | Turnus: halbjährlich (WS+SS) |
|                                                                                                                                     | Sprache: Englisch            |

### Lehrveranstaltungen:

Please check **UnivIS** for further lectures/seminars

**NB:** no overlap with courses in Mandatory Module allowed!

#### Mandatory courses:

##### A. Lab course:

Attendance in lab courses is compulsory!

Lab Course Advanced Physical Chemistry (WS 2018/2019, Praktikum, 7 SWS, Guido Sauer et al.)

##### B. Lectures & Seminars:

(please choose additional 6L and 2S), e.g.

##### **B1: Characterization of Nanosized Systems (2L)**

Characterization of Nanosized Systems (WS 2018/2019, Vorlesung, 2 SWS, Dirk Guldi)

##### **B2: Organic thin films (2L/1S)**

Organic Thin Films (WS 2018/2019, Vorlesung, 2 SWS, Rainer Fink)

Seminar Organic Thin Films (WS 2018/2019, Seminar, 1 SWS, Rainer Fink et al.)

##### **B3: Modern Methods in Mass Spectrometry (2L/1S)**

Modern Methods in Mass Spectrometry (WS 2018/2019, Vorlesung, 2 SWS, Thomas Drewello)

Seminar Modern Methods in Mass Spectrometry (WS 2018/2019, Seminar, 1 SWS, Thomas Drewello et al.)

##### **B4: Symmetry and Group Theory (2L/1S)**

Symmetry and Group Theory (WS 2018/2019, Vorlesung, 2 SWS, Jörg Libuda)

Seminar Symmetry and Group Theory (WS 2018/2019, Seminar, 1 SWS, Jörg Libuda et al.)

##### **B5: Interface Science and Catalysis (2L/1S)**

Advanced Physical Chemistry I - Interface Science and Catalysis (WS 2018/2019, Vorlesung, 2 SWS, Jörg Libuda)

Advanced Physical Chemistry I - Seminar Interface Science and Catalysis (WS 2018/2019, Seminar, 1 SWS, Jörg Libuda)

##### **B6: Solar Energy conversion (2L)**

Solar Energy Conversion (SS 2019, Vorlesung, 2 SWS, Dirk Guldi)

##### **B7: Formation and characterization of supramolecular nanoparticles (2L/1S)**

Formation and Characterization of Supramolecular Nanoparticles (WS 2018/2019, Vorlesung, 2 SWS, Franziska Gröhn)

Seminar Formation and Characterization of Supramolecular Nanoparticles (WS 2018/2019, Seminar, 1 SWS, Franziska Gröhn et al.)

##### **B8: Modern techniques in surface science (2L/2S)**

Modern Techniques in Surface Science (SS 2019, Vorlesung, 2 SWS, Christian Papp et al.)

Seminar Modern Techniques in Surface Science (SS 2019, Seminar, 1 SWS, Christian Papp et al.)

##### **B9: Metallic Nanoparticles in medicine (2L)**

Metallic Nanoparticles in Medicine (SS 2019, Vorlesung, 2 SWS, Carola Kryschi)

##### **B10: Catalysis & Kinetics (2L/1S)**

Catalysis and Kinetics (SS 2019, Vorlesung, 2 SWS, Jörg Libuda)

Seminar Catalysis and Kinetics (SS 2019, Seminar, 1 SWS, Jörg Libuda et al.)

##### **B11: Advanced Electrochemistry (2L/1S)**

Energy-related Advanced Electrochemistry (SS 2019, Vorlesung, 2 SWS, Christian Ehli et al.)

Seminar Energy-related Advanced Electrochemistry (SS 2019, Seminar, 1 SWS, Dirk Guldi et al.)

### Inhalt:

**A:** Advanced course lab experiments and/or lab project close to actual research topics

**B1:** Fullerenes; carbon nanotubes; graphene; endohedral metallo fullerenes; peapods; carbon nanohorns and nanoions; synthesis and analytical techniques.

**B2:** Preparation techniques (Langmuir-Blodgett films, self-assembled monolayers, sublimation, spin-casting, spraying), self-assembly, structural and spectroscopic analytical techniques, heterostructures, phase diagrams.

**B3:** Ionisation methods (EI, CI, FD, FI, SIMS, FAB, MALDI and ESI), ion formation mechanisms, analysers (ToF, sector field, quadrupole, ion trap, FT-ICR, orbitrap), tandem mass spectrometry, ion activation and fragmentation, thermochemical and analytical applications.

**B4:** Symmetry of molecules, symmetry operations and point groups; symmetry of periodic systems; compact course to group theory; group theory and quantum mechanics; symmetry and spectroscopy: vibrational spectroscopies; tensor description of physical properties; band structures.

**B5:** Surfaces of metals, oxides and ionic crystals; surface analytical techniques; bonding of molecules to surfaces: bonding mechanisms; Blyholder model; adsorbate interactions and superstructures; temperature programmed desorption/reaction; concepts and definitions in catalysis; microkinetics of catalytic processes; transport limitations; surface dynamics and surface kinetics; model catalysis.

**B6:** Energy portfolio; electron transfer; Si solar cells; dye-sensitized solar cells; organic photovoltaics; multiple excitation generation cells; photosynthesis; artificial photosynthesis

**B7:** Self-assembly of surfactants; self-assembly of more complex amphiphilic molecules; interaction forces in colloidal systems; osmometry; light scattering; form factor as key to particle shape; dynamic Light Scattering; fractionating Methods for Nanoparticle Analytics; combined Use of Characterization Methods; supramolecular nanoparticles by H-bridges and metal coordination; special Behaviour of polyelectrolytes; nanostructures with polyelectrolytes

#### Lernziele und Kompetenzen:

The students are able

- to understand the advanced principles of experimental techniques in physical chemistry
- to evaluate the application of experimental and/or theoretical techniques in modern material science/materials research
- to plan and perform advanced lab experiments and/or lab project related to actual research topics in physical chemistry
- to utilize selected preparation techniques for sample preparation
- to apply and understand modern experimental methods for sample characterization
- to interpret and to critically summarize their experimental results in written form (lab report, sometimes in paper-style format).

#### Literatur:

Manuscripts for most lectures available on **StudOn** or lecturers' website

#### Studien-/Prüfungsleistungen:

Physikalische Chemie - Physical Chemistry (Prüfungsnummer: 30803)

(englische Bezeichnung: Physical Chemistry)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 45

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

**Assessment and examinations:** O45 (PL) + LAB (SL): oral examination (45 min, 2 examiners) + lab course protocol(s), ungraded

**Calculation of the grade for the module:** 100% from oral examination

Prüfungssprache: Englisch

Erstablegung: SS 2019, 1. Wdh.: WS 2019/2020

1. Prüfer: Jörg Libuda

#### Organisatorisches:

**Intended stage in the degree course:** Mandatory elective module (Wahlpflichtmodul) or Elective Module (Wahlmodul) semester 1 - 3

**Frequency of offer:** **A:** upon appointment with course lab supervisor or research lab supervisors  
**B1-B5, B7:** winter term, **B6, B8-B11:** summer term

**Bemerkungen:**

Courses of study for which the module is acceptable: M.Sc. Molecular Science (as mandatory elective module) and M. Sc. Chemistry (as elective module). \*)

) **No overlap with courses in Mandatory elective Module "Interface phenomena" or Mandatory Module allowed!**