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| <b>Modulbezeichnung:</b> | <b>Molecular nanoscience (MSM-nano)</b><br>(Molecular nanoscience)                                          | <b>30 ECTS</b>               |
| Modulverantwortliche/r:  | Andreas Hirsch                                                                                              |                              |
| Lehrende:                | Andreas Hirsch, Dirk Guldi, Julien Bachmann, Rainer Fink, Christian Papp, Hubertus Marbach, Franziska Gröhn |                              |
| Startsemester: SS 2020   | Dauer: 2 Semester                                                                                           | Turnus: halbjährlich (WS+SS) |
| Präsenzzeit: 450 Std.    | Eigenstudium: 450 Std.                                                                                      | Sprache: Englisch            |

### Lehrveranstaltungen:

Attendance in Lab Courses is compulsory!

#### **Mandatory courses (A): Lectures & Seminars:**

A1: Supramolecular Chemistry I (2L) & II (2L)

A2: Nanoparticles and nanostructured thin films I (1L) & II (1L)

A3: Nanoparticles I (2L) & II (2L)

A4: Molecular Nanoscience SEMINAR I (2S) & SEMINAR II (2S)

A5: LAB COURSE Molecular Nanoscience (7LAB)

Supramolecular Chemistry - Molecular Materials II (SS 2020, Vorlesung, 2 SWS, Andreas Hirsch)

Nanoparticles II (SS 2020, Vorlesung, 2 SWS, Rainer Fink)

Seminar Molecular Nanoscience II (SS 2020, Seminar, 2 SWS, Franziska Gröhn et al.)

Lab Course Molecular Nanoscience/Molecular Materials (SS 2020, Praktikum, 7 SWS, Rainer Fink et al.)

#### **Elective courses (B) (in total 9 SWS\*):**

Courses of the student's choice related to the module and with approval by the representative of the study course

#### • **choose a minimum of 4 lectures (2L each) and 1 seminar (1S)**

B1: Characterization of nanosized systems (2L)

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

B3: Formation and characterization of supramolecular nanostructures (2L/2S)

B4: N.N.

B5: Nanoscale semiconductor materials (2L)

B6: Modern techniques in surface science (2L/2S)

B7: Metallic Nanoparticles in medicine

Nanoscale semiconductors (SS 2020, Vorlesung, 2 SWS, Julien Bachmann)

Modern Techniques in Surface Science (SS 2020, Vorlesung, 2 SWS, Christian Papp et al.)

Seminar Modern Techniques in Surface Science (SS 2020, Seminar, 1 SWS, Christian Papp et al.)

Metallic Nanoparticles in Medicine (SS 2020, Vorlesung, 2 SWS, Carola Krysch)

### Inhalt:

**A1:** Concepts in supramolecular chemistry; host-guest chemistry; energetics of supramolecular complexes; experimental methods; templates and self-assembly. Molecular devices. Supramolecular catalysis: principles of supramolecular catalysis, supramolecular metal catalysis, self-assembled catalysts, metal-free catalysis, enzyme mimics, antibodies, imprinted polymers.

**A2:** Synthesis of n-dimensional nano-materials. Systematic approaches towards nano-particles of defined size and structure are the basis to prepare materials with tailor-made electronic, optical or catalytic properties. The interplay between nano-particles, nano-rods, nano-wires, 2- and 3-dimensional materials are highlighted.

**A3:** Nanoscaled systems, general issues of microscopic techniques; experimental techniques with nanometer resolution: STM/AFM and 8 related scanning probes; light microscopy, confocal microscopy; electron microscopy (SEM, TEM, FEM/FIM, LEEM, PEEM), x-ray microscopy and synchrotron radiation.

**A4:** Specific topics in synthesis and analysis of specific molecule-based nanoscale objects

**A5:** focused topics in fundamental and applied research on nanoscale materials

### Lernziele und Kompetenzen:

The students are able

- to explain the fundamental chemical and physical properties of nano-scale materials
- to distinguish and to compare some properties, structure and applications of different nanomaterials
- to describe and to evaluate the major concepts in supramolecular chemistry

- to explain the general issues of selected microscopic techniques and to evaluate their applications to different materials
- to prepare and to characterize nano-sized samples (thin films, nano-tubes, molecular materials, nanoparticles) using selected experimental methods and techniques (includes experiment planning and data evaluation)
- to interpret and to critically summarize measurements results in written (lab report in paper-style format) and partly oral form
- to get used to perform research-related experiments within a smaller team.

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**Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:**

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

**[1] Molecular Science (Master of Science)**

(Po-Vers. 2013 | NatFak | Molecular Science (Master of Science) | Pflichtmodul Molecular Science)

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**Studien-/Prüfungsleistungen:**

Molecular Nanoscience (Prüfungsnummer: 30701)

(englische Bezeichnung: Molecular Nanoscience)

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

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

Assessment and examinations: O45 (PL) (45 min, 3 examiners) + LAB (SL)

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

Prüfungssprache: Englisch

Erstabledung: WS 2020/2021, 1. Wdh.: SS 2021

1. Prüfer: Andreas Hirsch

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**Organisatorisches:**

**Frequency of offer:** Annually/start of studies is available in summer and winter term Courses "I" in winter term, courses "II" in summer term

**A5:** LAB Course upon individual appointments with respective contact persons

**B1 - B3:** winter term

**B5-B7:** summer term

**Bemerkungen:**

**Courses of study for which the module is acceptable:** M.Sc. Molecular Nanoscience, Mandatory module