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| <b>Modulbezeichnung:</b> Molecular nanoscience (MSM-nano)<br>(Molecular nanoscience)                                | <b>30 ECTS</b>               |
| Modulverantwortliche/r: Andreas Hirsch  |                              |
| Lehrende: Dirk Guldi, Rainer Fink, Franziska Gröhn, Andreas Hirsch, Christian Papp, Julien Bachmann, Carola Kryschi |                              |
| Startsemester: WS 2019/2020   | Dauer: 2 Semester            |
| Präsenzzeit: 450 Std.   | Eigenstudium: 450 Std.       |
|   | Turnus: halbjährlich (WS+SS) |
|   | Sprache: Englisch            |

### Lehrveranstaltungen:

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

##### **A1: Supramolecular Chemistry I & II:**

Supramolecular Chemistry I / Molekulare Materialien I, Supramolekulare Chemie I (WS 2019/2020, Vorlesung, 2 SWS, Andreas Hirsch)

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

##### **A2: Nanoparticles and nanostructured thin films:**

Nanoparticles and Nanostructured Thin Films / Nanopartikel und nanostrukturierte dünne Schichten (WS 2019/2020, Vorlesung, 2 SWS, Julien Bachmann)

Nanoparticles and Nanostructured Thin Films / Nanopartikel und nanostrukturierte dünne Schichten - Seminar (WS 2019/2020, Seminar, Julien Bachmann)

##### **A3: Nanoprobes I (2L) & II:**

Nanoprobes I (WS 2019/2020, Vorlesung, 2 SWS, Rainer Fink)

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

##### **A4: Molecular Nanoscience SEMINAR I & II:**

Seminar Molecular Nanoscience I (WS 2019/2020, Seminar, 2 SWS, Franziska Gröhn et al.)

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

##### **A5: LAB COURSE Molecular Nanoscience:**

attendance in lab course is compulsory!

Lab Course Molecular Nanoscience / Praktikum Molecular Nanoscience (WS 2019/2020, Praktikum, 7 SWS, Rainer Fink 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:**

Characterization of Nanosized Systems (WS 2019/2020, Vorlesung, 2 SWS, Dirk Guldi)

##### **B2: Organic thin films:**

Organic Thin Films (WS 2019/2020, Vorlesung, 2 SWS, Rainer Fink)

Seminar Organic Thin Films (WS 2019/2020, Seminar, 1 SWS, Rainer Fink et al.)

##### **B3: Formation and characterization of supramolecular nanostructures:**

Formation and Characterization of Supramolecular Nanoparticles (WS 2019/2020, Vorlesung, 2 SWS, Franziska Gröhn)

Seminar Formation and Characterization of Supramolecular Nanoparticles (WS 2019/2020, Seminar, 1 SWS, Franziska Gröhn et al.)

##### **B4: N.N.**

##### **B5: Nanoscale semiconductor materials:**

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

##### **B6: Modern techniques in surface science:**

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.)

##### **B7: Metallic Nanoparticles in medicine:**

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

### 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.

### 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. 2007 | NatFak | Molecular Science (Master of Science) | alte Prüfungsordnungen | Gesamtkonto | Pflichtmodul Molecular Science)

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

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

### Studien-/Prüfungsleistungen:

Molecular Nanoscience (Prüfungsnummer: 30701)

(englische Bezeichnung: Molecular Nanoscience)

Prüfungsleistung, schriftlich oder mündlich

Anteil an der Berechnung der Modulnote: 50%

weitere Erläuterungen:

Oral examination (45 min) or alternative examination according to FAU Corona statutes!

Prüfungssprache: Englisch

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

1. Prüfer: Andreas Hirsch

### Organisatorisches:

**Frequency of offer:** 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