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**Modulbezeichnung:** **Molecular nanoscience (MSM-nano)** **30 ECTS**  
 (Molecular nanoscience)

Modulverantwortliche/r: Andreas Hirsch

Lehrende: Dirk Guldi, Milan Kivala, Rainer Fink, Franziska Gröhn, Hubertus Marbach, Andreas Hirsch, Jürgen Schatz, Julien Bachmann

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Startsemester: WS 2016/2017	Dauer: 2 Semester	Turnus: halbjährlich (WS+SS)
Präsenzzeit: 450 Std.	Eigenstudium: 450 Std.	Sprache: Englisch

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### Lehrveranstaltungen:

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

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

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

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

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

A5: LAB COURSE Molecular Nanoscience (7LAB) - attendance in lab course is compulsory!

Supramolecular Chemistry I / Molekulare Materialien I, Supramolekulare Chemie I (WS 2016/2017, Vorlesung, 2 SWS, Andreas Hirsch et al.)

Supramolecular Chemistry - Molecular Materials II (SS 2017, Vorlesung, 2 SWS, Andreas Hirsch)

Nanoparticles and Nanostructured Thin Films / Nanopartikel und nanostrukturierte dünne Schichten (WS 2016/2017, Vorlesung, 2 SWS, Julien Bachmann)

Nanoprobes I (WS 2016/2017, Vorlesung, 2 SWS, Rainer Fink)

Nanoprobes II (SS 2017, Vorlesung, 2 SWS, Rainer Fink)

Seminar Molecular Nanoscience I (WS 2016/2017, Seminar, 2 SWS, Franziska Gröhn et al.)

Seminar Molecular Nanoscience II (SS 2017, Seminar, 2 SWS, Franziska Gröhn et al.)

Lab Course Molecular Nanoscience / Praktikum Molecular Nanoscience (WS 2016/2017, Praktikum, 7 SWS, Rainer Fink et al.)

Lab Course Molecular Nanoscience/Molecular Materials (SS 2017, 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: Carbon allotropes - synthesis, properties and applications (2L/2S)

B5: Nanoscale semiconductor materials (2L)

Characterization of Nanosized Systems (WS 2016/2017, Vorlesung, 2 SWS, Dirk Guldi)

Organic Thin Films (WS 2016/2017, Vorlesung, 2 SWS, Rainer Fink)

Seminar Organic Thin Films (WS 2016/2017, Seminar, 1 SWS, Rainer Fink et al.)

Formation and Characterization of Supramolecular Nanoparticles (WS 2016/2017, Vorlesung, 2 SWS, Franziska Gröhn)

Seminar Formation and Characterization of Supramolecular Nanoparticles (WS 2016/2017, Seminar, 1 SWS, Franziska Gröhn et al.)

Carbon Allotropes: Synthesis, Properties and Application (SS 2017, Vorlesung, 2 SWS, Milan Kivala)

Nanoscale semiconductors (SS 2017, Vorlesung, 2 SWS, Julien Bachmann)

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### 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 | Masterprüfung | 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, mündliche Prüfung, Dauer (in Minuten): 45

Anteil an der Berechnung der Modulnote: 100%

weitere Erläuterungen:

Assessment and examinations: PL: Oral examination (45 min, 3 examiners), LAB (SL)

Prüfungssprache: Englisch

Erstablingung: SS 2017, 1. Wdh.: WS 2017/2018

1. Prüfer: Andreas Hirsch

1. Prüfer: Dirk Guldi

1. Prüfer: Franziska Gröhn

1. Prüfer: Rainer Fink

1. Prüfer: Julien Bachmann

#### **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

**B4/B5:** summer term

#### **Bemerkungen:**

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