BuildMoNa

UNIVERSITÄT LEIPZIG

## SCIENTIFIC AND METHOD MODULES

| Module name | Basic Concepts in Molecular Spectroscopy |
|---|---|
| **Number** | 2014-B4 |
| **Aims** | This module for physicists, chemists and biochemists introduces the basic concepts in molecular spectroscopy, i.e. Infrared (IR), (surface enhanced) Raman- with imaging options and Broadband Dielectric Spectroscopy (BDS), Nuclear Magnetic Resonance Spectroscopy, Optical Microscopy, Superresolution Microscopy, Single Molecule Fluorescence Detection, |
| **Basics** | The physical foundation of Infra-Red (IR) Spectroscopy and Broadband Dielectric Spectroscopy (BDS), Raman-, Surface Enhanced Raman-, Nuclear Magnetic Resonance (NMR) and Single Molecule Fluorescence Detection in the solid state, Light Scattering and surface sensitive spectroscopies with imaging options (Nanoscopy) will be presented in detail and some of its modern applications will be discussed. Additionally lab courses will be organized with demonstration experiments. |
| **Contents** | The quantum mechanical foundation of Infrared Spectroscopy; Experimental principles of Fourier Transform Infrared Spectroscopy; the principle of Broadband Dielectric Spectroscopy; modern Applications of Broadband Dielectric Spectroscopy; discussion of the chemical shift Hamiltonian with isotropic and anisotropic parts in NMR spectroscopy, the influence of sample orientation and molecular dynamics on the NMR signals, magic angle spinning, requirements for single molecule fluorescence detection at low and room temperature, optical microscopy schemes as well as microscopic detection beyond the diffraction limit |
| **Methods** | Seminars |
| **Type** | Two-day block course |
| **Date (month/year)** | July 21–22, 2014 |
| **Time** | See page 2 |
| **Work load** | 15 hours presence/45 hours self-study |
| **Examination** | Written examination, 25 July 2014, 15:00, Linnéstraße 5, Small Lecture Hall |
| **Credit points** | 2 |
| **Responsible scientists** | F. Cichos, D. Huster, F. Kremer |
| **Industrial partners** | - |
| **Recommendations for literature, e-learning** | C. E. Housecroft, E. C. Constable: "Chemistry", Pearson; P. W. Atkins: "Physical Chemistry"; Haken, H.; Wolf, H.C. “Molecular Physics and Elements of Quantum Chemistry: Introduction to Experiments and Theory” (Series: Advanced Texts in Physics) (englisch) Springer, Berlin, 2004, K. Schmidt-Rohr & H. W. Spiess: “Multidimensional Solid-State NMR and Polymers” Academic Press, San Diego, 1994, F. Kremer & A. Schönhals: “Broadband Dielectric Spectroscopy” Springer, Berlin, 2003<br>Bräuchle, Lamb, Michaelis, “Single particle tracking and single molecule energy transfer”, Wiley-VCH, Weinheim 2010, Rigler, Orrit, Basché , “Single molecule spectroscopy”, Springer, Berlin 2012 |

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**SCHEDULE for Module 2014-B4**

| Time | Lecturer | Programme | Location |
|---|---|---|---|
| **Monday, 21 July 2014** | | | |
| 8:30-10:00 | Frank Cichos | Optical Detection of Single Molecules in Hard and Soft Matter | Linnéstraße 5, Small Lecture Hall |
| | | *Coffee break* | |
| 10:15-11:45 | Frank Cichos | Optical Microscopy and Superresolution | Linnéstraße 5, Small Lecture Hall |
| 11:45-12:30 | Frank Cichos | Labtour and demonstration experiments | Linnéstraße 5 |
| | *Lunch break* | | |
| 13:30-15:00 | Friedrich Kremer | Fourier Transform InfraRed Spectroscopy | Linnéstraße 5, Small Lecture Hall |
| | | *Coffee break* | |
| 15:15-16:45 | Friedrich Kremer | Broadband Dielectric Spectroscopy | Linnéstraße 5, Small Lecture Hall |
| 16:45-17:30 | Markus Anton, Wilhelm Kossack, Emmanuel Urandu Mapesa | Labtour and demonstration experiments | Linnéstraße 5 |
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| **Tuesday, 22 July 2014** | | | |
| 8:30-10:00 | Daniel Huster | Static solid-state NMR line shapes | Härtelstr. 16-18, 017 |
| | | *Coffee break* | |
| 10:15-11:45 | Daniel Huster | Achieving High Resolution in Solids | Härtelstr. 16-18, 017 |
| 11:45-12:30 | Daniel Huster | Labtour and demonstration experiments | Härtelstr. 16-18 |

**Didactic elements:**
Lecture, discussions, practical training – lab demonstration, etc.

**Expected performance:**
Active participation in discussions during lab demonstration etc.

Doctoral candidates who have already received two credit points and a mark for the attendance of this module can participate, but cannot receive two graded credit points again or improve their mark.