ITMO University

Experimental Methods of Nanophotonics

Course Workload		Assessment form (examination/ graded test/ ungraded test)
ECTS	Hours	
6	216	Exam

Nanophotonics is a rapidly developing field, which aims at tailoring the optical properties of nanomaterials and understanding the optical phenomena arising near or beyond the diffraction limit of light. This course gives insights into contemporary tools and strategies for fabrication and experimental characterization of nanoscale optical devices and structures Being targeted at broad audience intending to work in areas related to nanophotonics, the course is both essential for experimentalists and provides important basic knowledge for theoreticians. Starting from nanofabrication technologies and methods of basic structural characterization, we will proceed to conventional and super-resolution optical imaging, spectroscopy and interferometry. The lectures are accompanied by advanced lab practices, lab projects and seminars on the most important achievements of modern science related to optics and photonics.

Course structure:

1. Methods of nanofabrication and structural characterization

1.1. Layer deposition. Wet and plasma chemical etching. Reactive ion etching.
1.2. Focused ion beam etching. SEM. E-beam lithography
1.3. Optical lithography
1.4. Chemical methods for nanofabrication
1.5. Scanning probe microscopy: STM and AFM

2. Fundamentals of optical microscopy

2.1. Basic optical elements: mirrors, beamsplitters, retroreflectors, polarizers and waveplates
2.2. Building simple optical systems. Telescope.
2.3. Infinity-corrected optical systems. Objective lenses
2.4. Resolution limit. Confocal microscopy. Methods of overcoming the diffraction limit
2.5. Building a confocal microscope

2.6. Near-field scanning optical microscopy.
2.7. Back focal plane microscopy. Measuring surface waves, singleparticle scattering and emission directivity

3. Fundamentals of optical spectroscopy

3.1. Optical detectors and sensors.
3.2. Dispersive elements. Optical spectrometer. Spectral resolution
3.3. Coherent and incoherent light. Spatial and temporal coherence.
3.4. Light sources. CW and pulsed laser radiation
3.5. Interferometers and their applications. Fourier-transform infrared spectroscopy
3.6. Atomic and molecular spectroscopy. Line broadening mechanisms. Jablonski diagrams
3.7. Luminescence and Raman spectroscopy. Tip-enhanced and surface enhanced spectroscopy
3.8. Optical spectroscopy of planar nano- and micro-devices.