M4425	Imaging Fluorescence Spectroscopy (CAI)

Coordinator (responsible lecturer)
Prof. Dr. Rüdiger Simon (Ruediger.Simon@hhu.de)

Lecturers
Dr. Stefanie Weidtkamp-Peters, Dr. Yvonne Stahl, Dr. Ralf Kühnemuth

Contact and organization
Dr. Yvonne Stahl

Workload	Credit points	Contact time	Self-study	Duration
420 h	14 CP	300 h	120 h	1 semester

Course components	Frequency	Group size
Practicals: 18 PPW Lectures: 2 PPW	each winter semester	12 students

Learning outcomes/skills
The students will be able to independently perform advanced fluorescence microscopic and spectroscopic techniques from sample preparation to data analyses in order to solve relevant biological questions. Using molecular biology techniques, the students can independently prepare samples that they analyze afterwards and evaluate in detail using advanced techniques like FCS, FRET-FLIM and FRAP. The students get to know the theoretical basis of fluorescence and its describing parameters like anisotropy, fluorescence quantum efficiency and fluorescence lifetime. The students will be able to describe the basic concepts of fluorescence microscopy and spectroscopy. They can explain and compare the pros and cons of the different fluorescent techniques, e.g. FCS (fluorescence correlation spectroscopy), FRAP (fluorescence recovery after photobleaching) and FRET (Förster resonance engery transfer) by acceptor photobleaching or FLIM (fluorescence lifetime imaging microscopy). They will also get to know advanced nanoscopic techniques. The students will be able to apply these techniques to solve different relevant biological questions and analyze and judge the results of their experiments.

Forms of teaching
Lecture, practical course, preparation and presentation of literature seminars, group work with discussion, preparation of documentation

Contents

Lectures:
In the lectures the basics of light and fluorescence microscopy and their application in relevant biological questions are taught. This includes the chemical and physical fundamentals of fluorescence, the properties of fluorescence and how these are determined. Additionally, the setup of fluorescence microscopes and the different fluorescence microscopy techniques are discussed. The students will get to know different techniques which employ fluorescence reporters in order to characterize the behaviour of proteins and biomolecules in cells and *in vitro*. Due to the content of the lectures, the students are supposed to understand and apply the theoretical fundamentals of these techniques to planning and performing of experiments during the practical part of the course.

Practical course:
The students will get to know and analyze the properties of fluorescence in some basic

spectroscopic experiments. Based on this they will apply different fluorescence techniques to two different model systems (human cell lines and tobacco leaves) in order to investigate the properties of different cellular proteins. Using the plant model system the students will get to know the complete course of events from planning, cloning of fusion proteins, molecular biology, transient expression in tobacco leaves and the following fluorescence microscopic experiments and their analyses. Here, the students will be faced with various difficulties, e.g. autofluorescence and movement of cells during the measurements and due to their acquired theoretical background they should be able to find solutions to these problems independently. Additionally, the students will get to know distinct fluorescence techniques on human cell lines, e.g. indirect immunofluorescence. The students will learn how to use a confocal laser scanning microscope (CLSM) in order to independently record images and z-stacks of fixed and live cells. The students will analyze the acquired data using the appropriate software. Imaging data shall be prepared in a way that conclusions about localization in different cell types can be drawn; live cell experiment data shall allow conclusions about e.g. interaction and mobility of proteins.

Requirements for admission
Formal: None
With regards to content: basic knowledge of microscopy and molecular biology is required

Type of examination
(1) Knowledge (80% of the mark): written examination (normal case) about the contents of lectures and practical course
(2) Documentation (20% of the mark): records in writing about analyzes and discussion of the different experiments

Requisites for the allocation of credit
(1) Pass of written examination
(2) Regular attendance and active participation in the practical course
(3) Records in writing that meet the standards of scientific documentation

Relevant for following study programmes/major (only MSc programme)
M.Sc. Biology
M.Sc. Biology International;

Compatibility with other curricula
M.Sc. biochemistry

Significance of the mark for the overall grade
The mark given will contribute to the final grade in proper relation to its credits.
M.Sc. Biology International: 14/44 CP

Course language
English

Additional information
Enrolling into the module is granted by the central study office of the Department of Biology.