Elitenetzwerk Bayern

UNIVERSITÄT BAYREUTH

Elite Study Program in Macromolecular Science

Module IP013

Advanced Interdisciplinary Lab Course

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Dr. Andreas Bernet

All assistants

Summer term 2013

This teaching module in the summer term 2013 within the Elite Study Program “Macromolecular Science” consists of an “Advanced Interdisciplinary Lab Course”. This lab course comprises an actual interdisciplinary practical course conducted in a team. Its aim is to gain practical knowledge about a model drug delivery system based on an amphiphilic diblock copolymer, which forms micelles in appropriate solvents. The students learn how to synthesize a polymer by free radical polymerization (for comparison purposes) and how to characterize diblock copolymers and aggregates of these diblock copolymers. The diblock copolymer micelles are loaded with an organic fluorophore as a model for a drug. Then the students study the uptake of these micelles into mammalian cells.

Series of consecutive experiments on the characterization of model diblock copolymer aggregates and their application in drug delivery:

I. Free radical polymerization of n-butylacrylate, preparation of the solutions for the characterizations, Size Exclusion Chromatography (SEC) and Nuclear Magnetic Resonance (NMR)

The students synthesize poly-n-butylacrylate (P-nBuAc) by free radical polymerization and prepare the different solutions needed for the characterizations of the two polymers (P-nBuAc and diblock copolymer). The characterization of the polymers with respect to molecular weight, polydispersity and composition (in case of the diblock copolymer) is carried out. Size exclusion chromatography (SEC) is used in order to determine the molecular weight and the polydispersity. The students determine the composition of the diblock copolymer by 1H-NMR. (LS Makromolekulare Chemie I; Contact person: Dr. Andreas Bernet, Email: andreas.bernet@uni-bayreuth.de)

II. Fluorescence Correlation Spectroscopy (FCS)

The students use FCS in order to selectively determine the diffusion constants of the diblock copolmer micelles, which are loaded with an organic fluorophore. The fluorophore is used as a model for a drug. The FCS is an important part of the training to understand the physical principles. By analyzing the FCS data a loading efficiency can be determined.
(LS Experimentalphysik IV; Contact person: Dr. Abey Issac, Email: Abey.Issac@uni-bayreuth.de)

III. Atomic Force Microscopy (AFM)

The students will prepare thin films of the diblock copolymers and determine the topography of these films. Also the different nature of the two blocks of the diblock copolymers is visualized by phase contrast. Thereafter the micelles are imaged and a rough estimate about their size distribution can be given. (LS Physikalische Chemie II; Contact person: Dr. Daria Andreeva, Email: daria.andreeva@uni-bayreuth.de)

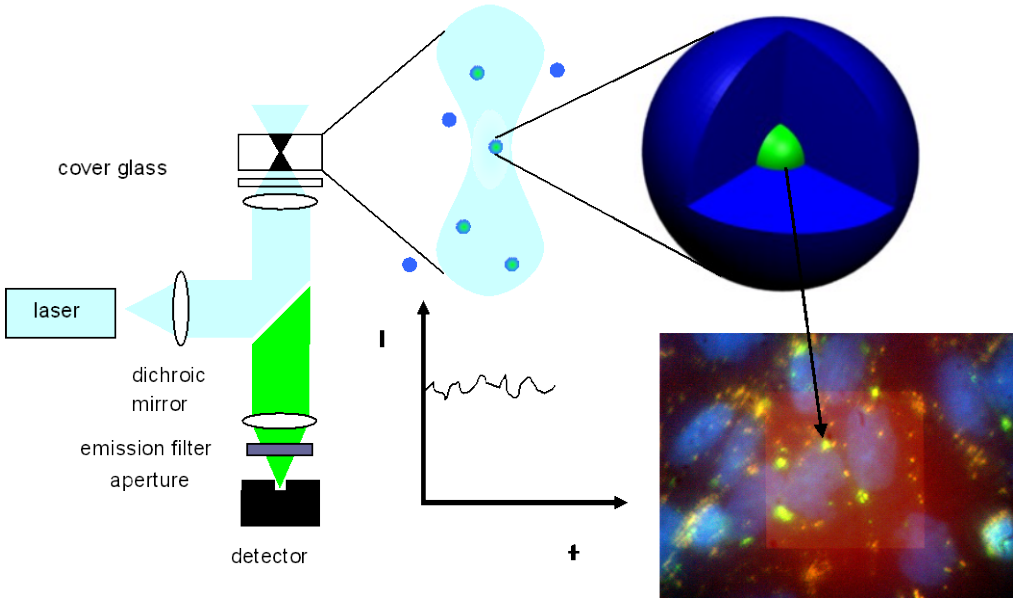

Figure 1. An FCS set-up used to characterize micelles, whose hydrophobic core is labeled by an organic fluorophore and a fluorescence microscopy image of mammalian cells, which have been exposed to an aqueous solution of these micelles.

IV. Nano-containers Uptake in Mammalian Cells

This practical course covers some basic manipulations typical for mammalian cell culture: work under sterile conditions in a laminar flow hood and enzymatic detachment of cells from substrates. Further on, the flow cytometry method is used to perform a quantitative analysis of nano-containers uptake, making use of the incorporated fluorescent dyes. Fluorescence Microscopy finally gives images of the cells and the distribution of the fluorescent drug model in them. (LS Bioprozesstechnik; contact person: Valerie Jérôme, Email: Valerie.jerome@uni-bayreuth.de)

PS: Please build a (interdisciplinary) group of two persons and then contact the research assistents/contact persons to fix the dates of the practical course.