MASTER OF SCIENCES

"ADVANCED SPECTROSCOPY IN CHEMISTRY"

Master Thesis - 30 ECTS credits
Spring 2018 (Semester 4)

Title: Synthesis, Characterization and Self-Assembling of Amphiphilic Polymers in Aqueous Media

University 1:	**University of Helsinki**
Main Laboratory:	**Department of Chemistry**
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Topic

Amphiphilic polymers are known to associate in aqueous media. Predictable self-organization into well-defined supramolecular assemblies is a main direction of the modern research. This research project involves three steps: synthesis of amphiphilic polymers, basic characterization and studies on their intermolecular interactions in aqueous media. The objectives are as follows.

1) Students are supervised to synthesize a polymer of choice, e.g. synthetic block or graft copolymers, derivatives or bio-conjugates based on cellulose, hyaluronic acid, etc. The polymers can either be well-known model compounds or novel polymers in order to assist a parallel PhD research.

2) Basic characterization of the synthesized polymer. This typically involves chromatography for molar mass and polydispersity of the sample and NMR spectroscopy.

3) Interactions between macromolecules will be investigated by means of light scattering: classical static light scattering (SLS) and quasi-elastic dynamic light scattering (DLS).

4) Depending on the polymer, additional methods can also be used: calorimetry, rheology, fluorescence, FT IR, field-flow fractionation etc.

This project provides students with essential theoretical and experimental skills for data analysis and results interpretation. Main focus will be on the light scattering methods. Such analytical instruments as liquid chromatography and field-flow fractionation are nowadays equipped with SLS and DLS detectors. Zetasizers have recently become a necessary tool in chemistry, biology and physics. Expertise gained during this Master project should help students to find job in modern analytical laboratories and industry.

keywords: amphiphilic polymer, nano particle, intermolecular interaction, self-assemby, light scattering

MASTER OF SCIENCES

"ADVANCED SPECTROSCOPY IN CHEMISTRY"

Master Thesis - 30 ECTS credits
Spring 2018 (Semester 4)

Title: Development of novel carbohydrate based chemicals and related applications

University 1: University of Helsinki
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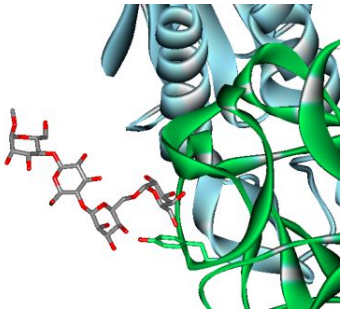
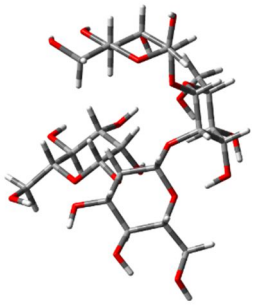
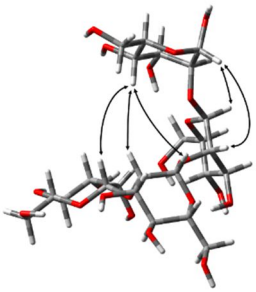
The supply of fossil raw materials, like coal and oil, are limited on earth. When the supply of these materials decline, the use of renewable raw materials or substances produced thereof may be a realistic answer to the challenge of keeping the high standards in society. As a result, utilization of renewable resources must be emphasized in future scientific planning. In Finland, like in any country with a developed forest industry, there is access to forest industry based raw materials e.g. carbohydrates (monosaccharides, disaccharides, oligosaccharides and polysaccharides). In order to make the production of carbohydrates more appealing and economically relevant their incorporation into fine chemicals, building blocks for more complex structures (e.g. pharmaceutical ingredients) and new types of materials must first be sorted out in a delicate way. While being the most abundant group of the renewable resources, carbohydrates also play an essential role in a wide range of biological recognition events and cell-cell communication processes. The wide occurrence of carbohydrates coupled with their biological significance have ensured that studies on the behaviour and applications of these resources are an attractive and important research topic in modern science. Within the scope of this project, the aim is to develop novel carbohydrate based chemicals and construct bioconjugates for advanced studies in the fields of chemistry and biology.







keywords: Biomolecular chemistry, bioconjugates, organic chemistry, structural characterization

MASTER OF SCIENCES

"ADVANCED SPECTROSCOPY IN CHEMISTRY"

Master Thesis - 30 ECTS credits
Spring 2018 (Semester 4)

Title: Spectroscopy of Polymer Materials

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Topic

The Master projects in the laboratory deal on one hand with polymer synthesis and on the other on the study of physical properties of polymers and hybrid materials. The focus of the research is mainly on self-assembling and environmentally responsive materials, which may find applications in for example controlled drug release systems, as potential vectors for gene delivery and in catalysis.

New controlled methods of polymer synthesis are utilised to build up complex polymer structures, whether they are block or graft copolymers, gels, or nanoparticles, often coupled with inorganic or biological matter resulting in hybrid materials. Also polymers of biological origin are studied, including wood components, other polysaccharides, proteins and DNA.

In the master project the focus is on mastering some of the important methods of polymer analysis. These include UV/VIS, fluorescence, liquid and solid state NMR spectroscopies, light scattering, mechanical spectroscopy (rheology and dynamic mechanical analyses). In the project, also synthetic work as well as supporting methods such as chromatographic methods may be employed.

Suggested research topics include for example:

Polymer nanoparticle catalysis studies by UV/VIS
Fluorescence spectroscopy on boronic acid binding to polymers
Rheological studies of thermoresponsive gels
Solid state NMR of block copolymers

keywords: polymer characterization, controlled polymerization, hybrid materials

MASTER OF SCIENCES

"ADVANCED SPECTROSCOPY IN CHEMISTRY"

Master Thesis - 30 ECTS credits
Spring 2018 (Semester 4)

Title: Study of cation sorption mechanisms on oxides by LIF

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Sorption mechanisms of metals, representing major radionuclides in nuclear waste, on metals oxides will be studied by laser induced fluorescence spectroscopy. Fluorescence spectra as a function of pH and metal concentration are recorded and the spectra shifts are utilized in identification of metal surface species. Oxides are either minerals or material designed for radionuclides removal processes from nuclear waste effluents. For example, see: https://helda.helsinki.fi/handle/10138/38126.

keywords:

MASTER OF SCIENCES

"ADVANCED SPECTROSCOPY IN CHEMISTRY"

Master Thesis - 30 ECTS credits
Spring 2018 (Semester 4)

Title: Interactions between ionic liquids and biomimetic membranes

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Topic

Ionic liquids (ILs) are composed solely of cations and anions and are defined as salts with melting points below 100 °C. They have received much attention due to their unique chemical and physical properties. ILs are often quoted as having low vapor pressures, low flammabilities and they are thermally and chemically stable. Therefore they are widely used in various pharmaceutical and industrial applications, such as in catalysis, organic synthesis, extractions, electroseparations, hydrometallurgy, and importantly for cellulose dissolution and in wood extraction. Despite the fact that their low vapor pressures minimize the impact of ILs on the atmosphere, their effect on water ecosystems and furthermore towards different aquatic organisms cannot be ignored or underestimated. Depending on the lipophilicity and alkyl chain length, the direct interaction between ILs and biological membranes might lead to bioaccumulation, induce disruption and leakage, and eventually even lead to cell death. Imidazolium based ILs have been under investigation in many studies but recently amidinium and guanidinium based ILs are becoming more widely used due to their recyclable structures for cellulose and hemicellulose processing.

In this project a large set of instrumental techniques will be used for getting detailed information on the interactions between ionic liquids and biomimetic membranes. Among the used methodologies are differential scanning calorimetry, nuclear magnetic resonance spectroscopy, dynamic light scattering, capillary electrophoresis, field flow fractionation, and surface sensitive methodologies. The interactions between ionic liquids and liposomes or bacterial cells will be investigated.

The project will give us new insight into the environmental aspects of ionic liquids in general. Specific focus will be on the relationship between the structure of the ionic liquid and its toxicity or harmfulness.

keywords: ionic liquid, liposome, cell, spectroscopy, spectrometry, toxicity