Self-assembly of polymers and surfactants

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European credits ECTS: 6

Teaching Language: English

Supporting files: English

	Number of course slots (1h20)	Number of course slots (3h)
Magisterial	19	
Tutorials	13	
Practical		3

Description

- Acquiring the theoretical and practical knowledge on surfactant properties in solution according to their chemical structure and environmental settings.
- Acquiring the theoretical and practical knowledge on the self-assembly properties of polymers and copolymers in bulk and solution as well as their characterization and applications.
- Acquiring a body of knowledge on the formulation and properties of gels obtained by self-assembly of polymers.

Outline

Part 1: Self-assembly of surfactants

Introduction to surfactants

- Colloidal scale
- Interfacial energy and surface tension

Surfactants in diluted solution

- Chemical structure and classification
- Micellization and CMC

Phase diagrams of surfactants

- Dilute range
- Generic phase diagrams and identification of phases

- Understanding of the phase behavior
- Concentrated range, generalization of the energy assessment and ternary representations

Some examples of applications

- Emulsions, dispersions, microemulsions

Thermodynamics of surfaces and interfaces

- Gibbs adsorption model
- Langmuir adsorption model

Part 2: Self-assembly of polymers in solution

Introduction

- Examples of self-assembled structures from biological macromolecules
- Keys concepts in the solution self-assembly of macromolecules

*Self-assembly of charged polymers (polyelectrolytes)*General interest of block copolymers

- Structure and properties of polyelectrolytes
- Weak and strong complexes of polyelectrolytes: structure, thermodynamics and kinetics
- Examples of assemblies from polyelectrolytes

Self-assembly of amphiphilic block copolymers

- Surfactant vs. block copolymer self-assembly
- Techniques for studying self-assembly
- Morphology and thermodynamics of self-assembly
- Theory and simulation
- Dynamics of micellization
- Examples of block copolymer self-assembly

Part 3: Self-assembly of polymers in bulk

Introduction to self-assembly phenomena in Soft Matter

Theoretical background:

- Flory-Huggins Theory
- Application to polymer blends
- Phase separation by “nucleation and growth” or “spinodal decomposition”
- Relationships between free-energy diagram and phase diagram

Block copolymer self-assembly

- Parameters describing block copolymer self-assembly and phase diagram
- Weak and strong segregation limits

Determination of block copolymer phase diagram

- Order/disorder& order/order transitions

- Scattering and microscopy techniques applied to block copolymer structures

Complex block copolymer systems

- Effect of chain architecture
- Rod-coil copolymers
- Copolymers and homopolymers blends

Applications of block copolymers in nanotechnologies

Part 4: Polymer Gels

Generalities

- Gel definition
- Example of applications
- Gel signature

Chemical gels

- Gelation and percolation concept
- Gel characterization
- Chemical gels: gelation kinetics, mechanical properties and swelling
- Drawbacks /advantages of chemical gels.

Physical Gels

- Gelation
- Different types of physical gels
- Supramolecular and transient network