CH975-10 Polymer Colloids

26/27

Department
Chemistry
Level
Taught Postgraduate Level
Module leader
Stefan Bon
Credit value
10
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module will explore how Polymer Colloids are made and behave.

Module web page

Module aims

The overall aim of this module is to provide an in-depth study of key topics of polymer colloid science and their underlying and founding physical principles.

The aims are to:

(1) gain a deep understanding of the scientific ideas and concepts associated with three selected core topics (polymer colloid synthesis, colloid motion, and colloid stability)

(2) Apply the gained knowledge in a discussion format to discuss examples of colloidal materials to improve learning.

(3) Place the gained knowledge into a wider scientific context linking to principles of chemistry, chemical engineering, physics, and manufacturing.

(4) Develop a skill set to critically process, understand, and communicate/explain scientific

principles and phenomena in the area of colloid science.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The module will give students a solid understanding of several fundamental and contemporary aspects of polymer colloid science.

The module is divided into THREE key learning blocks.

BLOCK 1: INTRODUCTION TO COLLOIDS & SYNTHESIS OF POLYMER COLLOIDS BY (MINI-)EMULSION POLYMERIZATION

In this block we will discuss:

Introduction to colloids: what is a colloid? Phases and colloidal systems. Specific properties. Ancient colloids. The importance of surface area. Capillarity. Laplace pressure. Variety of shapes. Lyophilic vs. lyophobic colloids. Emulsion polymerization: what is an emulsion polymerization and how does it differ from a suspension polymerization, dispersion polymerization, precipitation polymerization, and miniemulsion polymerization? A brief history of emulsion polymerization. Pro's and con's of emulsion polymerization vs. bulk/solution polymerization. A typical recipe. Mechanistic understanding of Emulsion Polymerization: rate of polymerization, particle formation (micellar and homogeneous nucleation), particle growth, particle swelling, diffusion limitation/starved conditions, compartmentalization, zero-one vs. pseudo bulk polymerization kinetics, Trommsdorf effect. Miniemulsion polymerization: What is miniemulsion polymerization? Ostwald ripening, how to retard/arrest Ostwald ripening.

BLOCK 2: ON COLLOID MOTION AND RHEOLOGY In this block we will discuss

Motion of colloids: gravity, buoyancy, drag force (Newton/Rayleigh/Stokes), terminal velocity, Brownian motion, Osmotic pressure, Stokes Einstein (Smoluchowski/Langevin), Barometric height, Ballistic velocity, Propulsion on the microscale (Purcell). Kinetics of coagulation Rheology: We will (re-) introduce rheological concepts and apply these to colloidal dispersions. Key words: kinematics and dynamics, shear rate, stress, viscosity. Yield stress, visco-elasticity, shear thinning and thickening. Hydrodynamic effects. Brownian contributions. Flocculation and thixotropy (Reversible time effects).

BLOCK 3: COLLOID STABILITY Colloidal stability: How to prolong the lifetime of a lyophobic colloid. Electrostatic stabilization. DLVO theory. Steric stabilization. Bridging and depletion flocculation. After recapping ways to stabilize colloids via electrostatic, steric, or depletion methods, we will look in detail into the DLVO theory. Key words: charged interfaces, van der Waals interactions, Hamaker coefficient, Derjaguin approximation, Coulomb repulsion, double layer, critical coagulation concentration.

Learning outcomes

By the end of the module, students should be able to:

- KNOWLEDGE: The module will provide students with a solid understanding of several fundamental and contemporary aspects of colloid science focussing on three key learning blocks (colloid synthesis, colloid motion, colloid stability). Students will develop specialized knowledge in the area of colloid science and integrate this across the wider areas of chemistry, chemical engineering, physics and manufacturing.
- DIVERSE PERSPECTIVES: Through 20 interactive teaching sessions and a group project students will be able to evaluate diverse points of view embedded within varying frameworks which may include, technological/scientific context, societal and environmental impact, temporal and trending contexts.
- COMPETENCY SKILLS: Students will engage in critical inquiry and develop their skill set to process, understand, and communicate/explain and evaluate scientific principles and their impact.
- APPLIED LEARNING: This module has a designed set of exercises associated with each block of learning in which concepts will be applied and integrated in an interactive discussion format.

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

Understand the underlying mechanistic and physical concepts of polymer colloids from a chemical engineering perspective.
Develop your mathematical modelling skills using Python as a coding tool.

Transferable skills

(RSC KR9): – communication skills
– scientific writing, data presentation, referencing literature
– problem solving skills relating to qualitative and quantitative information
– numeracy and mathematical skills
– sourcing of information
– digital skills, for example coding
– teamworking
– time management and organisational skills
– understanding of the scientific method
(RSC KR10):
– problem solving
– critical thinking skills within data analysis and experiment design
– learning skills required for professional development
– communication and interaction with other disciplinary areas
– hypothesis-based research and controls
– reflective practice

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (20%)
Private study	80 hours (80%)
Total	100 hours

Private study description

Independent learning: PDF-book.
exam prep incl exam times.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B

Assessment component	Weighting	Study time	Eligible for self-certification
Written Examination	100%		No

Open book exam. No access to digital devices apart from non-programmable calculators.

Reassessment component is the same

Feedback on assessment

Overall exam feedback will be provided

Past exam papers for CH975

Availability

Courses

This module is Core for:

- Year 1 of TCHS-F1PK Postgraduate Taught Polymer Chemistry
- Year 1 of TCHA-F1PW Postgraduate Taught Polymer Science

This module is Core optional for:

- Year 1 of TCHS-F1PK Postgraduate Taught Polymer Chemistry
- Year 1 of TCHA-F1PW Postgraduate Taught Polymer Science

This module is Optional for:

- Year 1 of TCHA-F1PX Postgraduate Taught Analytical and Polymer Science

This module is Option list A for:

- Year 1 of TCHA-F1PW Postgraduate Taught Polymer Science