CH982-10 Physical Properties of Polymers and Nanocomposites

26/27

Department
Chemistry
Level
Taught Postgraduate Level
Module leader
Tara Schiller
Credit value
10
Module duration
2 weeks
Assessment
25% coursework, 75% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

N/A

Module web page

Module aims

The ability to characterise polymers/composites and link this to their observable properties is crucial for all applications. This module will cover many advanced aspects of this. In particular, diffraction and scattering techniques and how polymer physical properties affect their processability. Students will be given the chance to obtain real data in the laboratories and link this to the lecture material.
This module also aims to introduce the concepts of nanocomposites, processing and expand students' knowledge in the characterization of bulk/solid phase polymer materials. This will be put in the context of both commodity and non-commodity materials, widely used in industry.
Topics covered will include: chain conformation models, molecular composition, thermal properties, mechanical properties, electrical and optical properties, polymer compounding, microscopy techniques, rheological techniques, diffraction techniques; polymers types and their

properties: polymer extrusion; polymer composites and nanocomposites. Relationship with properties and structure. Some examples of Applications. Sustainability and life cycle analysis.

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.

Main categories of polymers/plastics, industrial relevance/application
Molecular composition of polymers
Thermal Properties of polymers
Glassy state and Glass-Rubber transition of polymers
Semi- crystalline polymers
Rubbery and Liquid phases of polymers
Visco-Elasticity behavior of polymers
Rheological properties of polymers
Determination of mechanical properties of polymers
Concepts of stiffness, strength, strain and toughness
Static mechanical properties, impact and tear testing
Dynamic mechanical properties
Advanced Polymer Characterization including:
Electron microscopies (TEM, SEM and other combination techniques including EDAX)
Advanced scattering techniques including WAXS, SAXS from solution and solid state
Synchrotron methods and applicability to industrial polymers
Polymer compounding
Network Polymers
Polymer blends
Block copolymers
Solution self-assembly of block copolymers
Polymer processing
Extrusion
Injection moulding
Resin Transfer moulding
Composites and Nanocomposites
Sustainable biomaterials
Life Cycle Analysis

Learning outcomes

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

- Understand the chain conformation and its effect on micro and macroscopic properties of polymers.
- Demonstrate understanding of the parameters affecting thermal and mechanical properties of polymers and the methods to characterise their properties.
- Understand, characterize and interpret the phase separation of polymer blends or block copolymers.

- Understand a range of polymer processing techniques and be able to critically evaluate their appropriateness for different polymeric and composite materials and applications.
- Understand the reasons (physical) for when selecting polymers and composites for bulk material properties
- Demonstrate an understanding of the composition and how to obtain nanocomposite materials
- Understand a range of polymer processing techniques and be able to critically evaluate their appropriateness for different applications.
- Demonstrate understanding of the need , and how to interpret, high-resolution imaging and diffraction data in the context of polymer and composite structure
- Understand the processes and requirements for polymer processing

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

Subject knowledge and understanding:

- Understand the chain conformation and its effect on macroscopic properties of polymers.
- Demonstrate understanding of the parameters affecting thermal and mechanical properties of polymers and the methods to characterize the thermal and mechanical properties.
- Understand, characterize and interpret the phase separation of polymer blends or block copolymers.
- Understand a range of polymer processing techniques and be able to critically evaluate their appropriateness for different applications.
- Understand the reasons (physical) for when selecting polymers for bulk material properties
- Demonstrate an understanding of the composition and how to obtain advanced nanocomposite materials
- Understand a range of polymer processing techniques and be able to critically evaluate their appropriateness for different applications.
- Demonstrate understanding of the need , and how to interpret, high-resolution imaging and diffraction data in the context of polymer and composite structure
- Understand the processes and requirements for polymer processing

Key Skills:

- Communicate verbally and in writing
- Demonstrate understanding of the applicability of different techniques to analyse composite materials and different polymeric materials
- Demonstrate the ability of literature search and reporting of experiments
- Manage time effectively

Cognitive Skills:

- Critically analyse data

- Comprehensively assess errors in data
- Test hypotheses using experimental data
- Interpret results using information from literature.
  Subject-Specific/Professional Skills:
- Follow good and safe practice in the laboratory.
- Demonstrate labroaotry skills in the analysis of bulk polymer materials
- Produce clearly written and original scientific reports.
- Research and reference relevant literature.

Transferable skills

Scientific/Report writing
Problem Solving and Specifically Self-Direction and Originality
Critical Thinking within Data Analysis and Experiment design

Study

Teaching split

Provider	Weighting
WMG	85%
Chemistry	15%

Study time

Type	Required
Lectures	27 sessions of 1 hour (27%)
Tutorials	1 session of 2 hours (2%)
Demonstrations	1 session of 2 hours (2%)
Practical classes	12 sessions of 1 hour (12%)
Private study	57 hours (57%)
Total	100 hours

Private study description

Self study (extended reading, preparation of assessed work/lab report, tutorial work, revision etc.)

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D7

	Weighting	Study time	Eligible for self-certification
Assessment component			
Assessed Workshops/Labs 5/25 for attendance of practical sessions 20/25 Laboratory workshop assessment.	25%		Yes (extension)
Reassessment component is the same			
Assessment component			
Written Examination (Locally Held)	75%		No
Reassessment component is the same			

Feedback on assessment

Annotatation on student work, plus itemised mark sheet with formative feedback.

Past exam papers for CH982

Availability

Courses

This module is Core for:

- Year 1 of TCHA-F1PX Postgraduate Taught Analytical and Polymer Science
- Year 1 of TCHS-F1PK Postgraduate Taught Polymer Chemistry
- Year 1 of TCHA-F1PW Postgraduate Taught Polymer Science