

CH3F7-15 Energy

26/27

Department

Chemistry

Level

Undergraduate Level 3

Module leader

Ross Hatton

Credit value

15

Module duration

5 weeks

Assessment

20% coursework, 80% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

A dramatic transformation in the way that we generate and use energy is underway, motivated by the urgent need to address the threat posed by climate change and improve security of energy supply. Following an introduction to the wider context, the chemistry of a series of technologies, spanning energy generation, energy storage and energy use will be discussed.

[Module web page](#)

Module aims

1. To provide an overview of the science that underpins key renewable energy generation and storage technologies.
2. To show how materials chemistry is playing a critically important role in the advancement of emerging energy technologies.
3. To connect the science in this area with broader environmental, economic, social and policy issues.

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.

1. Introduction to the wider context (climate change, sustainability and energy security) and the central role chemists/materials scientists will play in addressing the challenges in this area.
2. Key concepts: Introduction to organic semiconductors; Estimating the energy gap between the valence and conduction band (HOMO/LUMO) in inorganic (organic) semiconductors; The role of defects in semiconductors.
3. The solar resource; semi-conductor p-n junctions applied to photovoltaics (PV); the motivation for reverting to thin film PV; operational principles behind quantum dot PV, dye-sensitised PV and organic PV (three disruptive classes of emerging PV technologies) and an explanation as to why these PVs operate differently to a conventional p-n junction PV. Key advances in materials development.
4. Fuel cells; basic principles of catalytic operation; proton exchange fuel cells; oxygen ion exchange fuel cells; key materials issues.
5. Solid state batteries; electrochemical principles, different types of batteries (primary, secondary); alkaline and lithium ion batteries; key materials issues.
6. Inorganic materials for batteries, solid-oxide fuel cells and electrocatalysis
7. Hydrogen; methods of generation (e.g. photoelectrolysis and chemical); importance of storage and transport; importance of new materials (e.g. porous framework materials).
8. Bioenergy; biomass as a fuel; bioenergy sources including crops and waste; production of gaseous and liquid fuels from biomass.

Learning outcomes

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

- Appreciate the connection behind the science and technology of energy, and environmental, economic, social and policy issues.
- Appreciate the complexity of the renewable energy challenge and the central role that chemists do/will play in this growing area.
- Understand the underpinning science behind the operation of different types of photovoltaic device, particularly leading emerging photovoltaic technologies.
- Understand the underlying principles behind different types of fuel cell.
- Understand the underlying principles behind the operation of solid state batteries.
- Understand the underlying principles behind bioenergy and the use of biomass for biofuels.
- Understand the underlying principles and challenges in the area of hydrogen storage.

Indicative reading list

[Reading lists can be found in Talis](#)

[Specific reading list for the module](#)

Interdisciplinary

Spans physical, materials, organic and inorganic chemistry

Subject specific skills

Problem solving
Critical thinking

Transferable skills

Problem solving
Critical thinking
Communication

Study

Study time

Type	Required
Lectures	21 sessions of 1 hour (14%)
Practical classes	4 sessions of 1 hour (3%)
Private study	125 hours (83%)
Total	150 hours

Private study description

N/A

Costs

No further costs have been identified for this module.

Assessment

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

Students can register for this module without taking any assessment.

Assessment group D1

Weighting**Study time****Eligible for self-certification****Assessment component**

Group presentation

20%

No

Cohort divided into groups of 4 students and assigned a topic (chosen by the academics delivering the course) on which they will prepare a 10-minute oral presentation pitched at year 3 undergraduate level, followed by 5 minutes of questions. Each student will contribute two slides to the group presentation. The group members will need to work together to ensure the contribution made by each person integrates well into the whole. The assignment topics will relate to recent developments in energy materials taken from the scientific literature. Assessed on presentation content/planning, presentation delivery and responses to questions

Reassessment component

Presentation

No

Reassessment will take the form of an A2 poster (i.e. a small poster) summarising a recent development in energy materials taken from the primary scientific literature (topic chosen by the academics), pitched at a level appropriate for a year 3 UG chemistry degree, together with a 2.5 minute recorded oral pitch.

Assessment component

Centrally-timetabled examination (On-campus)

80%

No

Written Examination

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- Periodic Tables
 - Students may use a calculator
 - Answerbook Pink (12 page)
 - Graph paper

Reassessment component is the same

Feedback on assessment

Cohort level examination feedback provided via Moodle. Individual written feedback on assessment provided to students via Moodle/Tabula.

[Past exam papers for CH3F7](#)

Availability

Pre-requisites

To take this module, you must have passed:

- All of
 - [CH277-15 Inorganic Materials from Complexes to Solids](#)

Courses

This module is Optional for:

- UCHA-4 Undergraduate Chemistry (with Intercalated Year) Variants
 - Year 4 of F101 Chemistry (with Intercalated Year)
 - Year 4 of F122 Chemistry with Medicinal Chemistry (with Intercalated Year)
- UCHA-3 Undergraduate Chemistry 3 Year Variants
 - Year 3 of F100 Chemistry
 - Year 3 of F121 Chemistry with Medicinal Chemistry
 - Year 3 of F125 MChem Chemistry with Medicinal Chemistry
- Year 4 of UCHA-F107 Undergraduate Master of Chemistry (with Intercalated Year)
- UCHA-F109 Undergraduate Master of Chemistry (with International Placement)
 - Year 3 of F109 MChem Chemistry (with International Placement)
 - Year 3 of F111 MChem Chemistry with Medicinal Chemistry (with International Placement)
- Year 3 of UCHA-4M Undergraduate Master of Chemistry Variants
- Year 4 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry (with Intercalated Year)