

# CH3G8-15 Molecules and Materials for the Modern World

**26/27**

**Department**

Chemistry

**Level**

Undergraduate Level 3

**Module leader**

Mark Senn

**Credit value**

15

**Module duration**

5 weeks

**Assessment**

20% coursework, 80% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

This module builds on core concepts covered in Year 1 and Year 2 to understand range of advance inorganic, organic and hybrid materials. The content will be divided based on parts of the mobile phone. e.g touch screen, data storage, capacitors, transistors, microphone/speakers, receivers/transmitters but with some functional materials having multiple applications. The final section will be focussed on going beyond Moore's Law and emerging materials and technologies.

### Module aims

By the end of the module, students should be able to appreciate the extent to which the touch screen smart phone has, since its introduction in 2007, transformed society and understand the complexity of modern technology in terms of the range of inorganic, organic and hybrid materials used in its construction, and the central role that chemists play in its development.

### 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 wider context: How the touch screen smart phone has transformed the way 85% of humanity now communicates, searches for information, shops, banks, navigates and accesses entertainment uses a smart phone. Likely directions for further innovation in capability.
2. The synthesis, chemistry and design of magnetic materials used in data storage: CrO<sub>2</sub> cobalt-based alloys (CoCrPt) ferrites (such as Fe<sub>2</sub>O<sub>3</sub>) and the future of data storage materials (e.g. PbTiO<sub>3</sub>).
3. The synthesis, chemistry and design of transparent conducting oxides: indium oxide doped with tin (ITO), indium doped zinc oxide and fluorine doped tin oxide. Compare and contrast properties / advantages of different transparent oxides.
4. Operating principle of the light-emitting diode (organic and inorganic) and transistor and liquid crystals
5. Light-emitting materials used in displays and lighting, including metal-organic complexes used in organic light emitting diodes, luminescent lanthanide based compounds (phosphors and pigments) and up-conversion nanoparticles. Singlets/triplets, Jablonski diagram, intersystem crossing.
6. High performance dielectric materials used in capacitors, microwave resonators, integrated circuits, displays, transistors (perovskite oxides, hafnium oxide, atomic layer deposition).
7. Beyond Moore's Law electronics: opportunities and challenges.
8. Design of single molecule wires, switches, diodes, transistors, memristor and sensors.

## Learning outcomes

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

- Appreciate the complexity of the smart phone in terms of the range of inorganic, organic and hybrid materials used in its construction, and the central role that chemists play in its development.
- Understand the synthesis, chemistry and design of: (i) Magnetic materials used in data storage; (ii) Transparent conducting oxides used for displays; (iii) Light-emitting and liquid crystal materials used in displays and lighting. (iv) Dielectric materials used in conjunction with all of the above.
- Appreciate that the electronics industry is now close to the limits of what can be achieved with existing materials, in large part because the size of electronic components has reached the quantum size regime.
- Understand how single molecules can be designed to function as nanoscale electronic devices (switches, wires, diodes etc) - potentially the 'beyond Moore's Law' future of electronics - and that chemists have a central role to play in the development of the field.
- Interpret and extract quantitative information from unseen sets of data (i.e. spectra, diffraction patterns and graphs) relating to each of the topics covered in the course.
- Perform simple calculations to determine physical quantities relevant to topics covered in the course.

## Indicative reading list

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

## Subject specific skills

Understanding of the synthesis and properties of a range of materials relevant to the modern technology, including magnetic storage materials, light emitting materials, transistors, liquid crystals, high performance dielectric materials etc.

## Transferable skills

Communication  
Critical Thinking  
Digital Literacy  
Information Literacy  
Problem Solving  
Professionalism  
Sustainability  
Teamwork

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## 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.

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## Assessment

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

## Assessment group D

	Weighting	Study time	Eligible for self-certification
<b>Assessment component</b>			
Ideas pitch	20%		No
Students prepare and deliver a presentation highlighting how current research trends in functional materials will impact future electronic technologies.			

Reassessment component is the same

**Assessment component**

Centrally-timetabled examination (On-campus)	80%		No
Written examination			

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

Reassessment component is the same

## Feedback on assessment

Cohort level examination feedback provided via Moodle following the Exam Board.

[Past exam papers for CH3G8](#)

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## Availability

### Courses

This module is Option list B for:

- UCHA-4 Undergraduate Chemistry (with Intercolated 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 UCHA-F110 Undergraduate Master of Chemistry (with Industrial Placement)
- 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)
- UCHA-4M Undergraduate Master of Chemistry Variants
  - Year 3 of F100 Chemistry
  - Year 3 of F105 Chemistry
  - Year 3 of F109 MChem Chemistry (with International Placement)
  - Year 3 of F125 MChem Chemistry with Medicinal Chemistry
- Year 4 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry (with Intercalated Year)