CH406-15 Electrochemistry and Nanotechnology

22/23

Department
Chemistry
Level
Undergraduate Level 4
Module leader
Julie Macpherson
Credit value
15
Module duration
6 weeks
Assessment
20% coursework, 80% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

N/A

Module web page

Module aims

The module is designed to develop student skills so that they are aware of current methods and directions at the forefront of electrochemistry and nanotechnology. Students will be able to be original in application of their knowledge to the solution of novel, research led problems.

A range of teaching methods will be employed including directed reading (papers and web-based material), problems classes, set exercises and oral presentation. Students will be expected to undertake a significant amount of student-centred learning around the subject, which will be directed during the 12 academic contact hours with the whole class. An additional contact hour a week will be set aside (as bookable) for students who have concerns with directed reading and student-centred learning. This will provide students with the opportunity to discuss their problems with an academic on an individual basis or as a group.

Two important and connected areas have been chosen: a) fundamentals and micro-nano scale aspects of dynamic electrochemistry and b) nanotechnology (molecular and nano-particulate building blocks through to device applications). These have been chosen given their importance in contemporary research and the internally-leading research in these areas in the Department.

Students will be expected to demonstrate their abilities by giving a short talk critically evaluating the scientific literature in a topical area. Students will test their critical thinking around the subject as well as their ability to apply their knowledge to original problems.

Students taking this module will have a grounding in internationally leading research in interfacial chemistry and nanotechnology. These are areas of great topicality in both academia and industry.

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.

This module will mainly focus on recent research in two main areas, specifically: a) dynamic electrochemistry and b) nanotechnology. Consequently the material in the module will be updated each year (as necessary) although the general areas covered will be identical on a year to year basis.

Syllabus
A compulsory set of 16 classes will be used to disseminate material in the following areas. 4 of these classes (2 per academic) will be used as an examples workshop and revision workshop.

Micro and NanoScale Electrochemistry

1. Key concepts (largely revision based) focused on fundamentals of dynamic electrochemical measurements
2. Mass transport versus electron transfer; micro- and nano-electrodes
3. Micro and nanoelectrode use in dynamic electrochemical imaging; control of mass transport and applications
4. Electrochemical Sensors
5. Micro and nanofluidics (lab-on-a-chip)

Nanotechnology

1. Key concepts (largely revision of concepts learnt in earlier years) relating to optoelectronic properties of molecular solids and the electronic structure of surfaces. New concepts include charge transfer doping of nanoscale materials and the push-back effect at molecule-metal contacts.
2. Engineering molecules as building blocks for single molecule devices.
3. Making electrical connection to single molecules: Approaches, Challenges and Complexity.
4. Single molecule devices: Wires, diodes and switches.
5. Low dimensional carbon (graphene and single –walled carbon nanotubes) as building blocks for nanoscale devices.
6. Nanoscale metal particles as building blocks for nanoscale devices, including an introduction to the plasmonic properties of nanoscale metals and how plasmonics can be exploited in nano-scale devices.

Learning outcomes

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

- Understand and be aware of current research and problems in dynamic electrochemistry and nanotechnology.
- Use their knowledge to critically evaluate recent research in the two areas of study.Assimilate and disseminate their knowledge at a level understandable by the general public in the form of an oral presentation

Indicative reading list

Electrochemistry

1. Lifting the lid on the potentiostat: a beginners guide to electrochemical circuitry and practical operation https://doi.org/10.1039/D1CP00661D
2. A Practical Beginner’s Guide to Cyclic Voltammetry, DOI: 10.1021/acs.jchemed.7b00361
3. Microelectrodes, R. J. Forster, Chem. Soc. Rev., 1994, 289.

Research element

e.g. essay, dissertation, individual or group research, research skills activity, etc.

Subject specific skills

Numeracy
Problem solving
Critical thinking
Written communication
Oral communication
Teamwork
Organisation and time management
Independence and initiative
Information literacy and research skills
Professionalism

Transferable skills

Numeracy
Problem solving
Critical thinking
Written communication
Oral communication
Teamwork
Organisation and time management
Independence and initiative
Information literacy and research skills

Professionalism

Study

Study time

Type	Required
Lectures	12 sessions of 1 hour (8%)
Practical classes	4 sessions of 1 hour (3%)
Other activity	8 hours (5%)
Private study	126 hours (84%)
Total	150 hours

Private study description

126 hours student-centred learning

Other activity description

4 workshops (2 examples classes and two revision sessions) plus 6-8 hrs attending presentations (including giving a 10 minute presentation and taking questions)
Bookable academic contact hour 2hrs

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 D3

	Weighting	Study time
10 minute oral presentation	20%	
In-person Examination	80%	

Feedback on assessment

Feedback comments and grade on assessed work (oral presentation) provided on copy of

marksheet. Cohort level examination feedback provided via Moodle.

Past exam papers for CH406

Availability

Pre-requisites

To take this module, you must have passed:

- Any of
  - CH3F1-15 Advanced Physical Chemistry and Laboratory
  - CH3F3-30 Advanced Chemistry (Organic, Inorganic and Physical)

Courses

This module is Optional for:

- Year 1 of TCHA-F1PB MSc in Chemistry with Scientific Writing
- Year 1 of TCHA-F1PE Postgraduate Taught Scientific Research and Communication
- UCHA-F110 Undergraduate Master of Chemistry (with Industrial Placement)
  - Year 4 of F110 MChem Chemistry (with Industrial Placement)
  - Year 4 of F112 MChem Chemistry with Medicinal Chemistry with Industrial Placement
- Year 5 of UCHA-F107 Undergraduate Master of Chemistry (with Intercalated Year)
- UCHA-F109 Undergraduate Master of Chemistry (with International Placement)
  - Year 4 of F109 MChem Chemistry (with International Placement)
  - Year 4 of F111 MChem Chemistry with Medicinal Chemistry (with International Placement)
- UCHA-4M Undergraduate Master of Chemistry Variants
  - Year 4 of F105 Chemistry
  - Year 4 of F110 MChem Chemistry (with Industrial Placement)
  - Year 4 of F109 MChem Chemistry (with International Placement)
  - Year 4 of F126 MChem Chemistry with Med Chem (with Prof Exp)
  - Year 4 of F125 MChem Chemistry with Medicinal Chemistry
  - Year 4 of F106 MChem Chemistry with Professional Experience
- Year 5 of UCHA-F127 Undergraduate Master of Chemistry with Medicinal Chemistry(with Intercalated Year)