Joanne Elliott BSc (Coventry), PhD (Southampton)

- Associate Professor in Physical Chemistry
- Athena SWAN ambassador
- Industrial Placement Tutor
- Careers Advisor for Chemistry Students

Lyotropic liquid crystals and templating:

- Aqueous solutions of bi-functional amphiphilic molecules are able to self-assemble to form mesophases showing a rich variety of ordered structures on the nanometre length scale. The mesophases arise because the amphiphilic molecules contain a water loving (hydrophilic) head group and a solvent hating (hydrophobic) tail; when mixed with water the resulting hydrophilic and hydrophobic interactions result in molecular aggregation. The degree of aggregation depends upon the nature of the amphiphilic molecule itself, the composition of the mesophase and the ambient temperature.
- The liquid crystal templating technique utilises the 3D aggregate structures formed by lyotropic liquid crystals as moulds around which a solid material may subsequently be formed. To prepare nanostructures materials via this templating route there are several prerequisites: presence of water, choice of template, precursor molecule and a reagent of some type. Under the right conditions the precursor molecules react, but only within the aqueous domains, to build up a solid mass of product. After reaction is complete the template is removed typically by leaching into a solvent. The material then has a nanostructure whose shape and dimensions are related to those of the original templating aggregate. The materials produced are referred to as mesoporous because the length scale of the associated nanostructure falls in the range 2-50 nm. This method has been shown to be useful for the preparation of a wide variety of materials such as metals/metal oxides/hydroxides and semiconductors.
- In collaboration with Dr Adam Squires a new methodology for designing electrode surfaces on the nanoscale has been developed. Referred to as inverse liquid crystal templating, the new low-cost method is environmentally friendly, has broad applicability and is amenable to scale-up. The method has been shown to produce high surface area electrodes, comprised of a nanowire network, that have widespread applications including electrocatalysis, sensor development and energy storage.

Original paper in this area:

Mesoporous platinum films from lyotropic liquid crystalline phases, Attard G.S., Bartlett P.N., Coleman N.R.B., Elliott J.M., Owen J.R., Wang J.H., *Science*, 1997, 278, 5339, 838-840

Most recent papers in this area:

Facile Production of Ordered 3D Platinum Nanowire Networks with "Single Diamond" Bicontinuous Cubic Morphology, Samina Akbar, Joanne M. Elliott*, Martyn Rittman, and Adam M. Squires*, *Adv. Mater.*, 2013, 25, 8, 1160-1164.

2D hexagonal mesoporous platinum films exhibiting biaxial, in-plane pore alignment, Kaleem Abbas Asghar, Joanne Margaret Elliott* and Adam Michael Squires, *J. Mater. Chem.*, 2012, 22, 13311-13317

Video link: Click here to view our video http://vimeo.com/41430399

Hydrodynamic modulation voltammetry:

- A new system for the generation of hydrodynamic modulated voltammetry (HMV) has been developed in collaboration with Dr Peter Birkin at the University of Southampton. This system consists of an oscillating jet produced through the mechanical vibration of a large diaphragm. A tapered jet system is assembled such that a relatively small vibration across a large diaphragm leads to enhanced fluid flow at the relatively narrow jet outlet. Positioning an electrode over the exit of the jet enables the detection of the modulated flow of liquid by following the electrochemical signal. This flow creates mass transfer rates typically of the order of 0.015 cm s^{-1}. However the fact that the flow is modulated means it can be used to create a HMV system where a 'lock-in' approach may be exploited to allow discrimination between surface controlled processes and those that are mass transfer dependent. This type of system is of particular interest for the study of nanostructured electrodes (of large surface area) where the large electrochemical signal due to surface reactions can often dominate the observed electrode response.

Most recent papers in this area:

Understanding the spatial mass transfer behaviour of a pulsating jet HMV system – Vortex generation and characterization, Peter R. Birkin, Jekaterina Kuleshova and Joanne M. Elliott, *Jnl of Electroanal. Chem*., 2013, 695, 47-52

Self-assembled monolayers and functionalised nanoparticles

- In collaboration with Prof W. Hayes self-assembly has been used to create functionalised electrode surfaces for analytical applications. This work has been extended in order to fabricate functionalised nanoparticles useful for sensing purposes and more recently functionalised nanoparticles have been incorporated into polymers to form healable supramolecular composite materials.

Most recent papers in this area:

Evolution of supramolecular Healable Composites; A mini-review, accepted for publication, Rajendran Vaiyapuri, Barnaby W. Greenland, Howard M. Colquhoun, Joanne M. Elliott and Wayne Hayes, *Polymer International*, DOI: 10.1002/pi.4685

Molecular recognition between functionalized gold nanoparticles and healable, supramolecular polymer blends – a route to property enhancement, Rajendran Vaiyapuri, R., Barnaby, Howard M. Colquhoun, Joanne M. Elliott and Wayne Hayes, *Polymer Chemistry,* 2013, 4, 4902-4909

A Thermoresponsive Supramolecular Polymer Network Comprising Pyrene-Functionalized Gold Nanoparticles and a Chain-Folding Polydiimide, Rajendran Vaiyapuri, Barnaby W. Greenland, Stuart J. Rowan, Howard M. Colquhoun, Joanne M. Elliott, and Wayne Hayes, *Macromolecules,* 2012, 45, 13, 5567-5574.

Pyrene-Modified Quartz Crystal Microbalance for the Detection of Polynitroaromatic Compounds, Rajendran Vaiyapuri, Barnaby W. Greenland, Joanne M. Elliott*, Wayne Hayes, Roger A. Bennett, Christine J. Cardin, Howard M. Colquhoun, Haitham Etman and Claire A. Murray, *Analytical Chemistry,* **83**, 16, 6208-6214