Project title: **Light-controlled molecular switches: understanding ultrafast photochromic processes in the gaseous and solution phases**  
Supervisor name(s): Dr Derek Wann and Dr John Moore  
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The prospect of studying the time evolution of matter at an atomic level, on the same timescale as bonds are made and broken, is extremely tantalising. Such knowledge is vital in our desire to better understand complex molecular systems. The techniques required to perform these experiments exist in York through Derek Wann’s time-resolved electron diffraction and John Moore’s spectroscopic studies. There will also be opportunities to get involved with collaborative projects in York and as far away as the Stanford Linear Accelerator Center (SLAC) in California and Christchurch in New Zealand.

This project will extend the use of the novel electron diffraction apparatus (right) and perform complementary studies using time-resolved spectroscopy and advanced computational methods. The electron diffraction experiments performed in York will have a time resolution of around 700 fs (limited by space-charge repulsion), and through collaborations at SLAC time resolution of better than 100 fs achieved by using the higher energy electrons). For both of these experiments we will be using ultrafast laser technology to produce short bunches of electrons, and utilising the same laser to photoinduce structural changes in a variety of molecular species that have industrial, medicinal, and astronomical relevance.

A specific focus of the research will be on studying mechanisms and quantum yields of light switchable materials. Using the range of methods available in the Wann and Moore groups we will be able to determine accurate structures for both long- and short-lived species and to probe differences in behaviour between gaseous, solution, and liquid-crystalline phases.

One example of the type of phenomenon that will be studied is the **cis-trans** photoisomerisation of **E**-cinnamonic acid (left), a highly topical molecule because spectroscopic signatures corresponding to its presence on Titan have been recorded by NASA’s Cassini probe during a recent fly-by. The isomerisation of **E**-cinnamonic acid is thought to lead to heterocyclic species such as quinoline in the dense clouds on Titan.

Another example involves studying highly interesting azobenzene derivatives include those with SCH₂CH₃ groups in the **ortho** positions on the aromatic rings. This class of derivatives displays enhanced photoswitching in the red region of the spectrum. As red light penetrates more strongly through biological tissue, this opens up a range of new biotechnology applications.

**Application closing date:** 17:00 on 11 January 2017  
**Interview date:** 15 February 2017

**Funding source:** EPSRC or Department of Chemistry  
**Funding scheme (if any):** DTG/Teaching Studentship  
**Funding Types:** Competition  
**Eligibility:** UK

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