Department of Chemistry: Part III Project 2017/18

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Title: Artificial Photosynthesis

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The development of hybrid materials and devices for producing clean, renewable energy is of great importance with respect to our future energy security and to reduce emissions of the greenhouse gas CO_2. Sunlight provides us with a practically inexhaustible flow of sustainable energy, and the photochemical conversion of solar to chemical energy in the form of sustainable fuels is an urgent yet challenging goal that cannot be achieved without major breakthroughs in basic research. Inspired by natural processes occurring in photosynthesis, the Reisner Laboratory develops artificial photosynthetic systems, where a light absorber – such as a molecular dye, or a semiconductor – is coupled with a chemical catalyst to use photo-generated charge carriers for the conversion of water or the greenhouse gas carbon dioxide into a renewable fuel.

The Part III project will mainly be developed around the student's scientific interest taking into account a current scientific challenge in our laboratory. Typically two projects are available each year and the student will work alongside a day-to-day supervising senior PhD student or postdoctoral scientist and guidance by Dr Reisner. Self-assembly of photosynthetic hybrid systems is a novel field of research and requires detailed understanding of the interface of redox catalysis and materials chemistry. We are particularly interested in the self-assembly of molecular catalysts for H_2 evolution and CO_2 to fuel conversion on nanostructured semiconductors. Such functional hybrid materials are prime candidates to form the basis for solar fuels generation in the future. Key examples of our work can be found on our website and representative recent publications, which could form the basis of a Part III project, are listed here:

(1) "Solar-driven reforming of lignocellulose to H_2 with a CdS/CdO_x photocatalyst."
Wakerley, Kuehnel, Orchard, Ly, Rosser & Reisner, *Nature Energy*, **2017**, *2*, 17021. - Link

(2) "Dye-sensitised semiconductors modified with molecular catalysts for light-driven H_2 production."
Willkomm, Orchard, Reynal, Pastor, Durrant & Reisner, *Chem. Soc. Rev.*, **2016**, *45*, 9–23. - Link

(3) "Electrocatalytic and Solar-driven CO_2 Reduction to CO with a Mn Catalyst on Mesoporous TiO_2."
Rosser, Windle & Reisner, *Angew. Chem. Int. Ed.*, **2016**, *55*, 7388–7392. - Link

(4) "Solar Hydrogen Production Using Carbon Quantum Dots and a Molecular Nickel Catalyst."
Martindale, Hutton, Caputo & Reisner, *J. Am. Chem. Soc.*, **2015**, *137*, 6018–6025. - Link