There is a clear need to develop processes that minimise the consumption of limited energy resources and reduce waste detrimental to the environment. Catalysis plays a central role for reducing waste and energy consumption and consequently is used in ca. 90% of industrial chemical products. Nevertheless, there is significant scope to develop new catalysis and apply energy more directly than simply heating, including solar energy. The focus of this proposal is heterogeneous photocatalysis, which would not only provide the benefits inherent to heterogeneous processes, including easy catalyst separation, but also exploit an essentially limitless supply of free energy.

The proposed research aims to use inorganic semiconductors to support light absorbing complexes or quantum dots coupled with a metal complex or nanoparticle catalyst for performing useful oxidation reactions. The aim is to use water and/or oxygen as the source of oxygen atoms for selective photocatalytic reactions. Development of photocatalysts that use water and oxygen avoid the stoichiometric use of strong oxidizing agents and their waste byproducts, which are typically used in industry.

Student training will include inorganic complex and materials synthesis, photochemistry, and electrochemistry. Training in separation techniques (for monitoring reactions) such as GC and HPLC will be provided. Many spectroscopic techniques will be used including NMR, IR, UV-Vis and Raman. In addition, an aim will be the construction of simple electrochemical devices to support mechanistic understanding of the catalyst system.

This project would be suitable for a student with a background in either chemistry or materials science.

References


Kumar, S; Parlett, CMA; Jowett, DV; Douthwaite, RE; Cockett, MR and Lee, AF. Facile synthesis of hierarchical Cu2O nanocubes as visible light photocatalysts. Applied Catalysis B: Environmental, 2016, 189, 226-232.

Ducrot, A; Coulson, B; Perutz, RN and Duhme-Klair, A-K. Light-induced Activation of a Molybdenum Oxotransferase Model within a Ru(II)-Mo(VI) Dyad. Inorganic Chemistry, 2016, DOI: 10.1021/acs.inorgchem.6b01485.

Funding source: Student to secure own funding

Eligibility: UK /EU/Overseas

All research students follow our innovative Doctoral Training in Chemistry (iDTC): cohort-based training to support the development of scientific, transferable and employability skills

For more information contact chemgrad@york.ac.uk or see our web page: http://www.york.ac.uk/chemistry/postgraduate/

The Department of Chemistry holds an Athena SWAN Gold Award and is committed to supporting equality and diversity for all staff and students.