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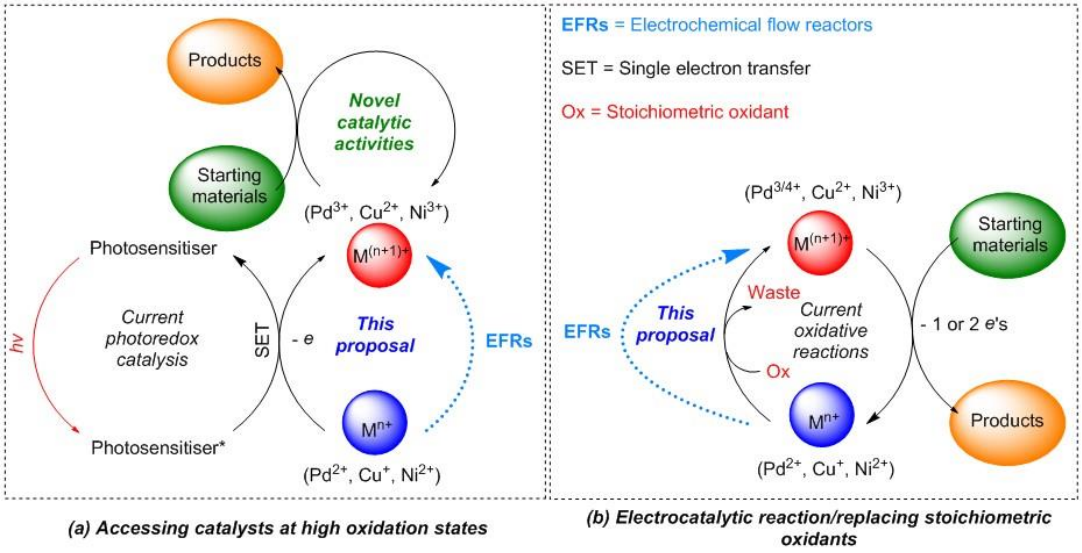
This proposal is representative of the projects currently on offer in our group. For more details of active research projects, please visit the link: http://www.chem.leeds.ac.uk/bao-nguyen/research-summary.html

Electrochemical Flow-Cells as Enablers for Catalytic Synthetic Processes

Catalysis research is a central area of modern synthetic science, which has made major advances in the last decades. Recent developments in synthetic research showed a resurgence of non-traditional processes employing photo-, electro- and mechano-chemistry. Photoredox processes, in particular, have been used to access higher, unusual oxidation states of metal catalysts, which lead to highly novel and powerful types of reactions, *e.g.* Pd-catalysed C-H activation, Cu-catalysed C-CF_3 coupling reactions, and Ni-catalysed C-O, C-C coupling reactions. This is an important and thriving area of synthetic science in which the current challenges are the need for a finely-tuned photosensitisers (*i.e.* redox potential), which can absorb light and initiate the reaction through a single-electron-transfer (SET) process, and the need for a stoichiometric oxidant in C-H activations (safety and sustainability issues). In addition, the photosensitisers are often expensive, based on precious metals, not readily available, and give low photochemical yields/slow reactions, hindering the wider application of these reactions.



(a) Accessing catalysts at high oxidation states *(b) Electrocatalytic reaction/replacing stoichiometric oxidants*

Scheme 1. A new paradigm in accessing novel catalytic activities through higher oxidation state of transition metal catalysts

In this project, the student will employ electrochemistry as an elegant solution to the limitations of catalytic processes at high oxidation states. By controlling the applied potential and designing flow electrochemical reactors, the desired SET of the metal catalyst can be achieved selectively (Scheme 1). This will take advantage of our recent success in using electrochemical flow-cells to make organometallic catalysts and to change oxidation state selectively.[1,2] Such flow processes are highly efficient, often resulting in quantitative conversion of electricity into chemical yield.

The project is best suited to a student with strong background and interest in synthetic chemistry and catalysis. No prior knowledge of reactor design or electrochemistry is required, as training will be provided for these important transferable skills. The student will also benefit from interdisciplinary training and seminar programmes in process chemistry as a member of the Institute of Process Research & Development, Leeds (http://www.iprd.leeds.ac.uk/).

More detail on this and other projects in asymmetric catalysis, recovery of precious metals, or CO_2 utilisation will be made available by contacting Dr Bao N. Nguyen at b.nguyen@leeds.ac.uk.

Funding Status: Competition Funded Project (Students Worldwide)

References

[1] M. R. Chapman, Y. M. Shafi, N. Kapur, B. N. Nguyen, C. E. Willans, *Chem. Commun.* 2015, *51*, 1282;
[2] http://generic.wordpress.soton.ac.uk/dial-a-molecule/electrochemically-switchable-catalysts-in-flow/.