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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 webpage at: http://www.chem.leeds.ac.uk/People/Sergeeva.html

Development of surface-supported organic photocatalysts

Functionalisation of the surface holds a promise to controllably tune and modulate its electrical, thermal, and photophysical properties and offer a broad range of applications. Surface supported nanostructures can take an advantage of the support in contrast to free-molecules. We have demonstrated that range of different organic dyes such as porphyrins can be successfully used in such strategy.[(1)] However, covalently modified surfaces with photoactive units, become increasingly important as they offer stability and show more superior properties in contrast to supramolecular interactions. We are interested in photochemical processes whereby highly reactive intermediates[(2)] can be generated through absorption of light by substrate. Such approaches are practical and time-saving as the reactions can be carried out under mild conditions and have no requirement of catalysts.

Our choice of chemistry will be governed by two main objectives: (i) modification of the surface by planar, electron-rich molecules sensitive to photochemical ET with high extinction coefficient in visible region; (ii) the reaction conditions allowing quick, efficient and large scale functionalisation. (photochemistry)

Different projects are available in this area, for example in: (i) development an innovative photocatalytic methodology for metal-free type of C-C bond formation for heteroarenes functionalisation e.g. trifluoromethylation; (ii) design and evaluation of the surface supported photocatalysts; (iii) understanding the kinetics and spectroscopy of the photoredox organocatalysis.

The student will gain an experience in synthesis, photochemistry and materials chemistry; learn to handle various hydroscopic, photo and air sensitive materials safely. Also, training will familiarise a student with vacuum, low temperatures and inert gas techniques; and analytical methods including chromatography, NMR, Raman, UV-vis and fluorescence spectroscopy. Photochemical potential of new hybrid materials will be evaluated by comparative analysis of their (photo)physical properties using the standard techniques and equipment available within the School.

References

[(1)] ACS Nano, 2014, 8, 5190–5198; Chem. Commun. 2014, 50, 3447-3449; [(2)] Angew. Chem., Int. Ed. 2015, 54, 10734−10750; Angew. Chem., Int. Ed. 2016, 55, 15476−15484.