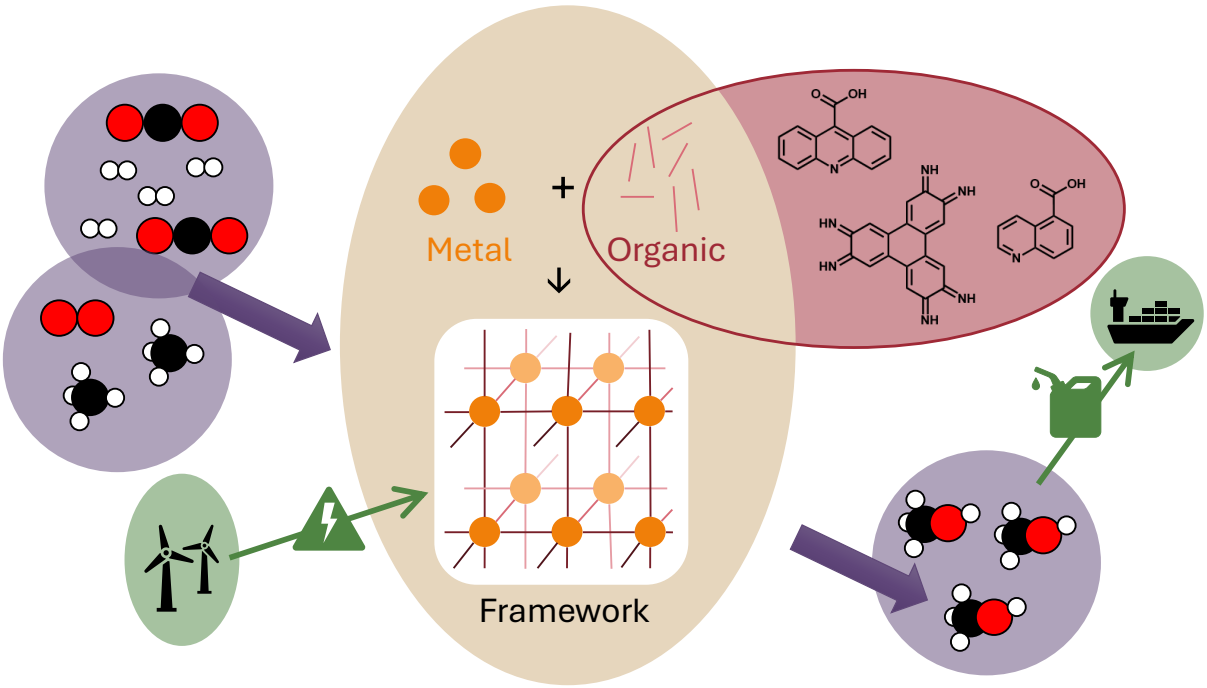
MSc project on electrocatalytic transformation of small molecules with metal-organic frameworks



Project overview

Using electricity to make chemical bonds is a great way of storing green energy, for example when renewables produce more energy than currently in demand. With the help of solid catalysts based on metal-organic frameworks (MOFs), abundant small molecules can be either electrocatalytically reduced to larger compounds with higher energy content [1] or oxidised in a controlled way, avoiding overoxidation [2]. Examples of such reactions include

ii) reducing CO_2 with H_2 to produce small hydrocarbons such as methanol or
ii) oxidising CH_4 from biogas with O_2 to produce methanol.

Master's students' Task

Please note that there are possibilities for several MSc projects within this area

1. Synthesis

Novel metal-organic frameworks with redox activity and ideally exhibiting electrical conductivity will be synthesised. The MOF syntheses will be carried out through wet chemical methods, using metal salts and organic molecules, which may be commercially available or custom-made. The catalyst may be deposited as a thin film or an ink for further electrochemical testing.

2. Characterisation

   The structural integrity, chemical nature, thermal stability, and porosity of the materials will be evaluated using standard X-ray diffraction, optical and NMR spectroscopic, thermal gravimetric, and gas adsorption techniques. The chemical identity and local structure of the catalytic sites require a mode of advanced characterisation, which shall be carried out at large-scale facilities in *e.g*. France, the UK, Sweden. There is a real possibility for the students to participate in such beamtimes.

3. Testing

   Following an assessment of redox activity and stability by cyclic voltammetry, promising materials prepared in the project will be evaluated in electrocatalytic studies in the liquid phase using electrolytes. This may be followed up with gas-phase experiments.

References

[1] Y. Y. Birdja *et al., Nature Energy* **2019**, *4*, 732-745.

[2] Xing *et al., Appl. Catal. B*, **2020**, 278, 119295

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Bonus

You will be part of a scientifically excellent, dynamic, and inclusive research group with lots of activities.



