The Strategic University Steel Technology and Innovation Network

Task 1: Carbon conversion

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EPSRC

Engineering and Physical Sciences Research Council

CDUK

UK Centre for Carbon Dioxide Utilisation

Task 1.1 High efficiency carbon capture

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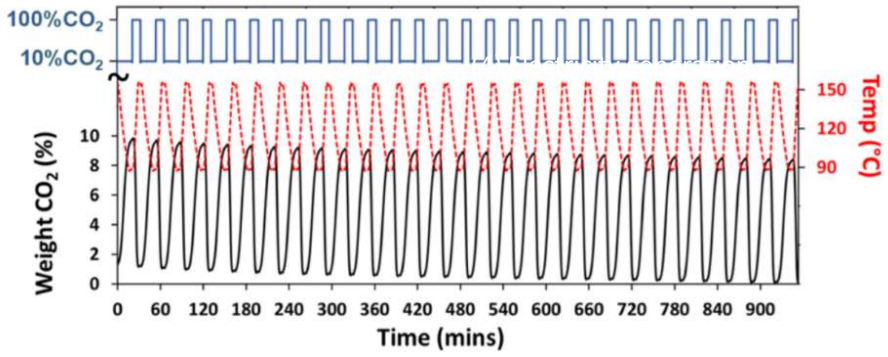
Aim

- State-of-art solid sorbent materials for CO_2 capture from steel-making emissions & process gas mixtures
- Focus on selectivity, robustness, and cost to address scalability of separation of complex gas mixtures

Approach

- Amine-based cross-linked porous sorbent materials
- Ionic liquids supported on cellulose
- Temperature & pressure swing sorption unit optimisation (TSA, PSA)



Amine-based cross-linked sorbent CO_2 capture performance

Output

- Carbon capture materials tailored for steel-making with lower energy demand and increased separation efficiency
- Scalability of sorbent production: cheap starting materials, green solvents, optimised separation process.

Task 1.2 CO_2 conversion - biorefinery

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Aim

- Increases compound yields of biorefinery using CO_2 emissions from steelmaking
- Rapid harvesting of algae, reducing large volumes, and fractionate high from low value products

Approach

- LED Photobioreactors: enhance growth rate of algae (1.8 kg CO_2 kg^{-1} of algal biomass)
- Membranes technologies: a cascade of membrane process with increasing product recovery capacity

Output

- LED technology increases compound yields by 30%
- Protein - £300/kg
- Omega-3 lipids - £100/kg
- Haematococcus – Xanthophyll - £2500/kg

Task 1.3 CO_2 conversion – chemicals/fuels

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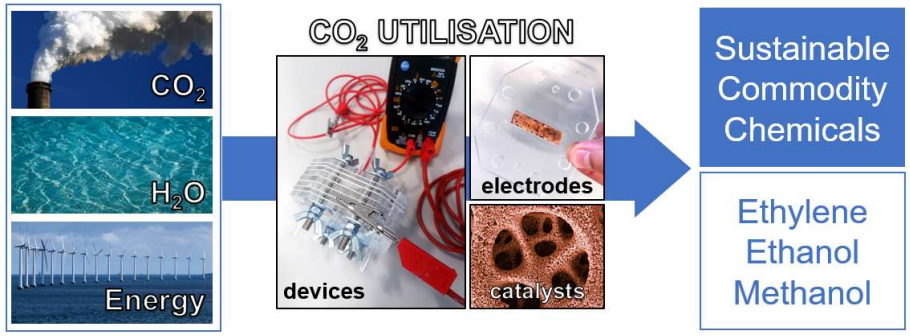
Aim

- Advanced electrocatalysts and system for CO_2 conversion to hydrocarbons and alcohols
- Enhancement of CO_2 conversion reactor for the production of fuels

Approach

- Gas diffusion electrodes for production of formate, methanol, ethanol, ethylene, etc. from CO_2
- Thermochemical reactor for CO_2 conversion to diesel, Jet fuel, methanol, DME



Electrochemical conversion of CO_2 to added value products

Output

- Enhance electrochemical rate of production (>100 mA/cm^2) and product selectivity (>60% for C1 products)
- Repurposed thermal reactor scaled from Batch to Flow, with potential (based on successful additional funding) to 0.25t/day of product