



Conference on CO₂-based Fuels & Chemicals 2023

Abstract Submission – Promethean Particles

Title: Metal Organic Frameworks (MOFs): Enabling Energy-Efficient Carbon Capture for the Growing CO₂ Utilisation Market

Speaker: Dr Selina Ambrose, Product Manager at Promethean Particles Ltd.

Carbon Capture and Storage (CCS) technologies go hand-in-hand with CO₂ utilisation processes to provide a multi-step solution in deep decarbonisation. While incumbent CCS systems primarily utilise commercialised liquid sorbents - namely amine scrubbers - these present technical, financial, environmental, and logistical limitations that hinder the adoption of CCS beyond large industrial plants and cluster hubs for point-source capture. For example, small and medium sized emitters require systems with a small-footprint, and an energy-efficient capture process which amines – and their accompanying, energy intensive re-boilers - do not offer. Moreover, such liquid sorbents require regeneration energies that are too high for viable use in Direct Air Capture (DAC) systems.

Solid sorbents present an innovative CCS option, with the potential to overcome many of the challenges presented by liquid amines. Metal-organic frameworks (MOFs) represent a promising class of novel solid sorbents due to their highly tuneable structures and surface chemistries, allowing for careful optimisation of CO₂ binding modes to minimise the regeneration energy required, while still achieving high uptake and selectivity in “real world” conditions. The solid nature of MOF sorbents also allows for the design of modular capture systems with a relatively small footprint, which can be readily retrofitted onto existing processes.

Although the advantages of MOFs as sorbents have been well published, these materials have been held back from industrial adoption in CCS applications so far, due to limited scale in supply and prohibitive costs. Promethean Particles is revolutionising the manufacture and supply of MOFs by using a game-changing continuous-flow production technology. This means high quality MOFs can now be offered beyond the tonne-scale, and at commercially-viable prices, to facilitate the large-scale deployment of point-source CCS and DAC solutions that are required globally for storage and utilisation.