Nano-trap Catalysts for Reducing Methane Emissions in Shipping Vessels

Student: Ashia McManus, Supervisors: Robert Raja [a] and Dominic Hudson [b]
[a] Chemistry & Chemical Engineering [b] Civil, Maritime & Environmental Engineering

Introduction

Shipping is a major source of **greenhouse gas emissions**

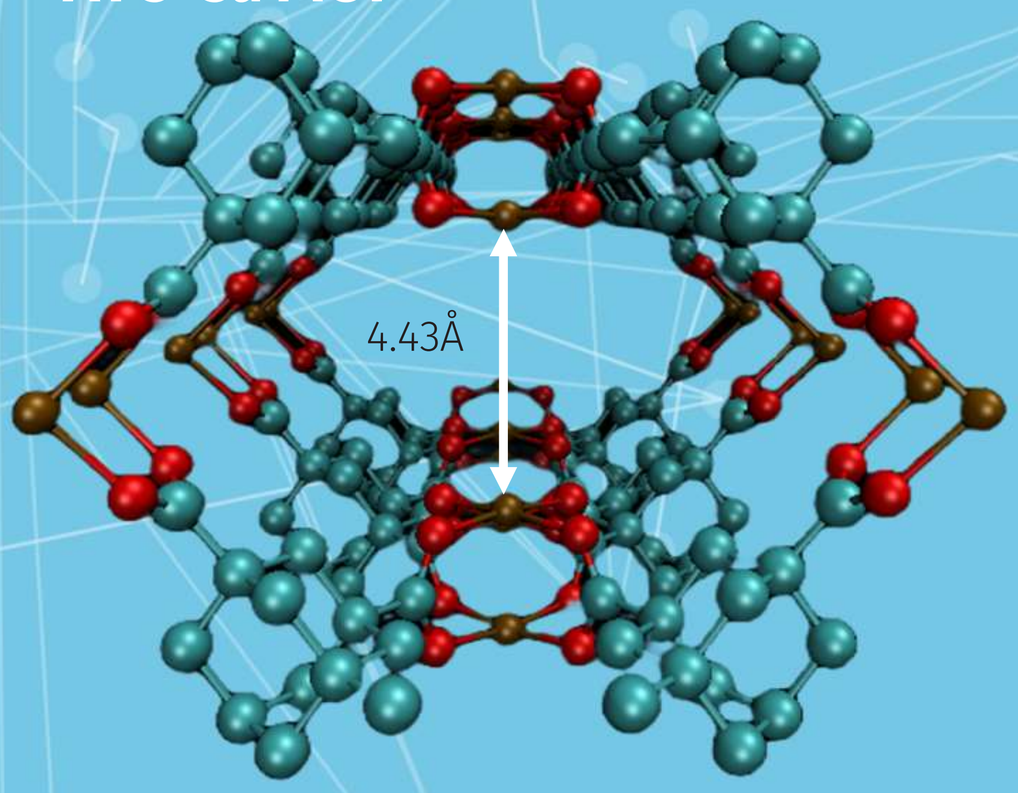
More and more ships are **using LNG** as an alternative fuel

LNG **minimises NO_x, SO_x and CO_2** emissions

Releases unburnt methane into the atmosphere

	Maintains engine efficiency	Does not produce CO_2	Reduce methane slip	Re-use Methane
In-cylinder methods	✗	✓	✓	✗
Total Oxidation Catalysts	✓	✗	✓	✗
Methane capture catalysts	✓	✓	✓	✓

ATC-Cu MOF

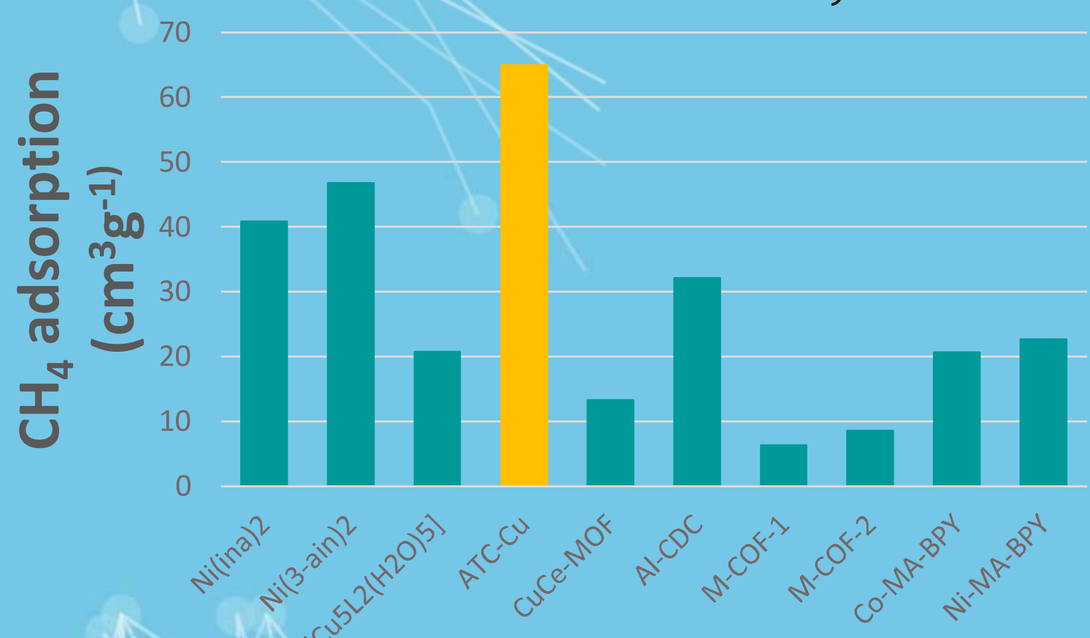


ATC-Cu[1] MOF contains 3D rectangular channels of dimensions 4.43 x 5.39Å where the proximity of the 2 copper sites mediates a 'nano-trap' for methane.

Methane Capture Catalysts

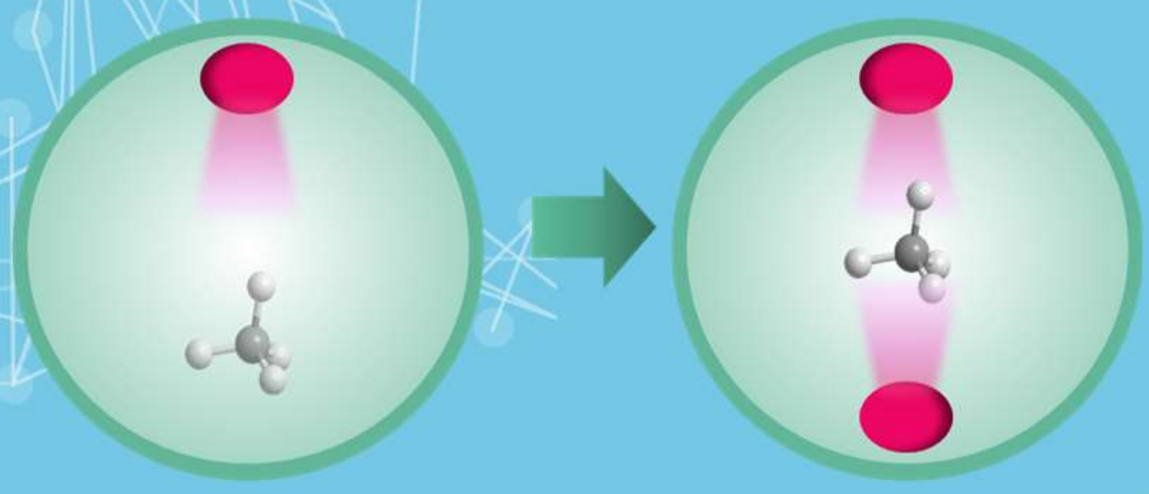
Metal Organic Frameworks (MOFs) are promising candidates for methane capture materials with advantageous features such as:

- Large surface areas
- Tuneable pore sizes
- Flexibility

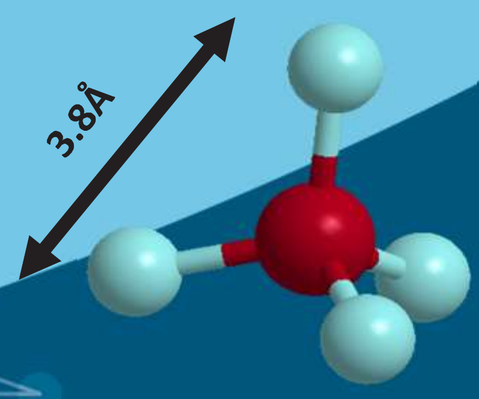


Currently, MOF ATC-Cu[1] displays the highest CH_4 adsorption ability of 64.96cm^3g^{-1} at 298 K and 1 bar.

Key features of a Methane Capture Catalysts



- ★ Di-metal centre for enhanced binding
- ○ Unsaturated metal centre
- ○ Alkyl groups within the pore
- ○ Appropriate pore size



SOUTHAMPTON MARINE & MARITIME INSTITUTE

References

[1] Z. Niu et al, Angew. Chem. Int. Ed., 2019, 58, 10138–10141.