Advanced MOF-based materials towards dual carbon dioxide capture and conversion

Simone Coelho Fernandes

up201603496@fc.up.pt

Supervisors: Luís Cunha-Silva[1], Salete S. Balula[1]

1. LAQV/REQUIMTE, Faculdade de Ciências da Universidade do Porto, 4169-007, Porto, Portugal

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PROBLEM:

Increasing global energy consumption:
85 % of total energy is still supported in fossil fuels

Excessive release of CO_2 to atmosphere

Increasing average global temperature

SOLUTION:

European Green Deal

PARIS AGREEMENT

- Climate neutrality by 2050
- Economy with net-zero greenhouse gas emissions, especially CO_2

decarbonization

STRATEGIES:

Capture

CO_2 capture and storage (CCS) in underground reservoirs is already being implemented

waste of abundant feedstock for valuable products

Conversion

CO_2 can be converted to value-added products without by-products, through an 100% atom economical route

One example of products with industrial interest are cyclic carbonates

Metal-Organic Frameworks (MOFs)

- Permanent and ordered porosity
- Crystallinity
- Robust and recyclable catalysts in several applications

MOF-based Materials

Activation of MOFs by:

Defect engineering MOFs crystalline structures (DeMOFs)

Supporting metallic nanoparticles in MOFs: materials (MNPs@MOFs)

Preparing porous MOF-silica hybrid composites (MOF/SiO_2)

MAIN OBJECTIVE:

Design of MOF-based materials with dual function:
CO_2 capture and conversion into useful products,
under ambient conditions (temperature and pressure).

REFERENCES:

1. Haszeldine, R. S. (2009). "Carbon Capture and Storage: How Green Can Black Be?" Science 325(5948): 1647-1652.
2. Gür, T. M. (2022). "Carbon Dioxide Emissions, Capture, Storage and Utilization: Review of Materials, Processes and Technologies." Progress in Energy and Combustion Science 89: 100965.
3. Pal, T. K., D. De and P. K. Bharadwaj (2020). "Metal–organic frameworks for the chemical fixation of CO2 into cyclic carbonates." Coordination Chemistry Reviews 408: 213173.

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