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New carbon capture materials: Novel Approaches to Post-Combustion CO₂ Capture

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Introduction

The most commercially viable capture method in carbon capture and storage (CCS) has been attributed to post-combustion carbon capture using chemical solvents. Although the conventional chemical solvents such as MEA solutions have high selectivity and capture capacity, they are highly corrosive and required high regeneration energy. In addition, volatilisation of MEA at elevated temperature and its release to the atmosphere can lead to major human and environment concerns. In this study two alternative carbon capture materials have been investigated.

- CO₂ solvent microcapsules where the CO₂ solvents are encapsulated within a CO₂ permeable polymer shells.
  - Adv. 1. Prevents direct contact of solvents with system.
  - Adv. 2. Reduction in solvent volatilisation.
  - Adv. 3. Provides much larger surface area and consequently increases the capture rate.

- CO₂ based imprinted polymers (CO₂-MIPs) where recognition cavities are created within the polymer, based on the target molecules (template)
  - Adv. 2. Stable capture efficiency in present of impurities.
  - Adv. 4. Lower required regeneration energy.

Experimental Setup

Numerical and Experimental Results

Conclusions

Production of two promising carbon capture material was investigated. Regarding the CO₂ solvent microcapsules both experiments and numerical modelling were used to study the effect of flow rates, fluid properties and microfluidic geometry to achieve an active control on the microcapsule size, shell thickness and the number of encapsulated inner droplets. The microcapsules with size 50-600 µm were produced. Concerning CO₂-MIPs, suspension polymerisation method was used to achieve spherical particles with controllable size over the range of 1-100 µm. The effect of operative parameters on particle morphology has been investigated. Both materials due to wide range of particle size can be used for industrial and domestic applications.