Design and Synthesis of Mesoporous Carbon for Selective Post-Combustion CO₂ capture

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Objective
- Design and synthesis of sorbents for CO₂ capture with both high capacity and favorable kinetics for flue gas applications

Introduction
- Global energy-related CO₂ emissions reached 30.4 gigtonnes (Gt) in 2010, and are projected to increase to 43.3 Gt by 2035.
- If cumulative emissions are less than 1,000 Gt, the probability for global warming beyond 2 °C is 25%; 1,440 Gt, 50%.
- Carbon capture and sequestration have the potential to mitigate Gts of anthropogenic CO₂ emissions
  - State-of-art capture technique: amine scrubbing
  - High energy penalty for regeneration; liquid evaporation; corrosive natures of the solutions
- Advantages of solid sorbents: low regeneration energy; flexibility over pore structures and surface functionalities

Synthesis of mesoporous materials

Liquid crystal template

Characterization
- Fig. a & b show the interconnecting macroscopic structure of the material
- Fig. c & d show hierarchical morphology which facilitates CO₂ sorption
- Fig. e & f show another tube like morphology with different synthetic condition

Sorption behaviors and CO₂ capacity

Compared to other works

Conclusion
- Design and synthesis of pyrrole derivative monomer facilitates micelle monomer co-assembly to achieve final mesophasic structure
- Rational design of Ordered Mesoporous Carbon with highest surface area and no structural shrinkage
- Observed highest CO₂ performance for mesoporous carbon results from high nitrogen loading and order hierarchical structure of the materials
- Fine tuning to further increase the surface area and CO₂ capacity