Effective CO_2 Capture by Covalent Organic Polymers through Amine Binding and N_2 Rejection

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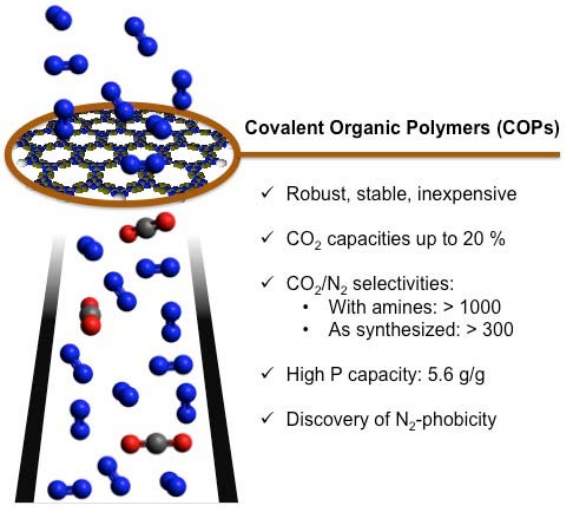
Control of carbon dioxide emissions without significant penalties requires effective CO_2 scrubbing from point sources, such as fossil fuel burning power plants, cement factories and steel making. Capturing process is the most costly; hence the research is directed to finding solutions to it. Solids with slight chemisorptive nature (35-50 kJ/mol binding energy) are most likely candidates for a sustainable solution. Nanoporous (pore size < 100 nm) materials show considerable CO_2 uptakes and are likely to replace monoethanol amine (MEA) solutions for industrial CO_2 capture. We have developed nanoporous covalent organic polymers (COPs), which show significant capacities and selectivities for CO_2. Surprisingly, azo (N=N) bearing COPs show lack of N_2-philicity by increasing temperature, in other words N_2-phobicity, leading to very high CO_2/N_2 selectivities. Under high pressures COP-1 shows a record high capacity of 5.6 g/g CO_2 uptake at 200 bar and 45 ^oC. COP-83 has a capacity of 5 mmol/g at 298 K and 1 bar, and COP-97 shows an uptake of 8 % (w/w) CO_2 in 2 minutes from a simulated flue gas mixture (CO_2 15%, H_2O 3.8%, He 81.2%, 40 C, flow rate: 80 mL/min). Our results point to an ideal nanoporous structure to be made from a highly porous, inexpensive, physisorptive solid, which is chemically modified with chemisorptive functionalities such as amines.



※ Reference: 1. **Chem. Mater.** 26 (23), 6729–6733 (2014), 2. **Chem. Eur. J.**, 20, 772-780, (2014), 3. **J. Mater. Chem. A**, 2, 12507-12512, (2014), 4. **Nature Commun.**, 4:1357, (2013), 5. **Adv. Funct. Mater.**, 23, 2270–2276 (2013), 6. **J. Mater. Chem.**, 22, 8431-8437 (2012), 7. **Chem. Comm.**, 48 (80), 9989–9991 (2012), 8. **Energy Environ. Sci.,** 4, 4528-4531 (2011)

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