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Exceptionally High CO_2 Capturing Capacity of Porous Organic Polymers

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Pre-combustion flue gas capture has been emerged as an efficient alternative to circumvent the costly procedures of materials regeneration utilized by the energy industry for CO_2 capture and separation. Stability of the porous structure and repeated use at high pressure and high temperature are among the essential requirements for the efficient materials to be used for industrial level CO_2 separation. Herein we report the CO_2 adsorption-desorption performance of nanoporous covalent organic polymers (COPs), which can operate efficiently and repeatedly at elevated pressure of 200 bars and above. Since, pre-combustion capture also requires removal of hydrogen along with CO_2; therefore, nanoporous COP was also tested for hydrogen removal at high pressure. COP material prepared with simple technique from building block monomers of cyanuric chloride and linked with 1,3-bis(4-piperidinyl) propane has enough surface area and pore volume which makes the material capable to store large quantity of syngas at high temperature and pressure. Results indicated that the newly synthesized COP material can adsorbed exceptionally large quantity of CO_2 and very little hydrogen at 200 bars and 35°C. Additionally, the adsorption isotherm was exactly matched with the desorption isotherm, suggesting the material has excellent adsorption-desorption characteristics. Similarly, the material has shown very stable performance when used repeatedly and alternatively for CO_2 and hydrogen after regeneration at 50°C. The capturing performance of material was also investigated for other gases like methane and nitrogen at various pressures and temperatures. Experimental results revealed that COP material has exceptional CO_2 adsorption efficiency, very good selectivity, and strong stability and can be manufacture with simple techniques. Lastly, material is economically attractive when it is compared with the commercially available materials and has exceptional performance contrary to activated carbon, metal organic frame work and monoethanole amine.

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