

Porous Organic Polymers for Advanced Gas Separation Applications

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Ever-increasing greenhouse gas emissions led to the development of novel functional adsorbents that can show remarkable gas uptake and separation efficiencies. In that regard, porous organic polymers (POPs) have gained tremendous attention due to their thermal and chemical stabilities, structural tunability, and control over textural properties. Two main parameters define the POPs' performance a large abundance of micropores and the presence of functional groups that selectively bind the target gas molecules. In this direction, we have synthesized various POPs containing macrocycles for advanced gas separation applications. The resulting POPs showed incredible CO₂ uptake capacities and IAST CO₂/N₂ selectivities of 137. We also tested various solvent uptake properties of larger macrocyclic POPs. Moreover, we also explored controlling the textural properties of POPs under solvothermal conditions. We used readily available and cheap table salt as a hard template to control the ratio of porosity of the final POP. Not only the BET surface area but also the ratio of the micropores and mesopores can be easily tuned by using different amounts of templates. The resulting salt-templated polymers were tested at high pressures, where the difference in the diffusion of gases to the pores was observed. While linear molecules such as CO₂ can go quickly in the pores, larger and bulky ones such as CH₄ and N₂ have very slow diffusion rates. Thus, high selectivity values were achieved.

