Advanced solid adsorbents for CO_2 separation

- Microporous Organically Pillared Layered Silicates -

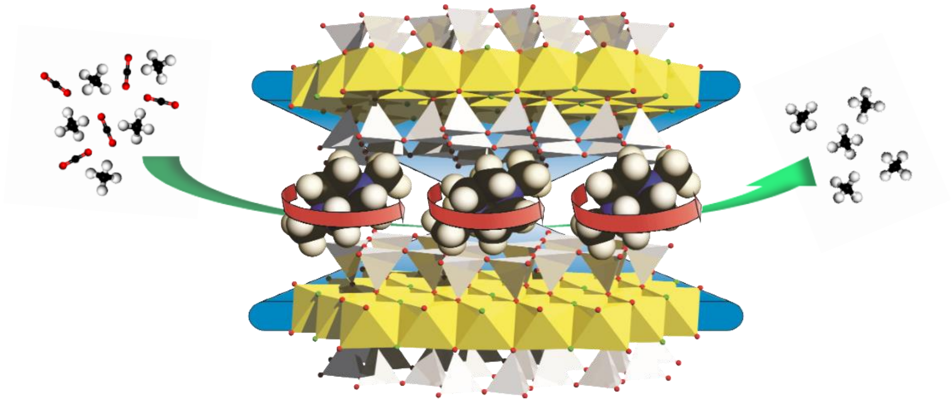
Rising CO_2 levels in the atmosphere pose a serious threat to humanity. We have already faced environmental consequences for our failure to address this major factor contributing to climate change. Solid adsorbent materials tailored for CO_2 separation are a key to meet our modern society´s need for sustainable technologies. In order to achieve the most efficient gas adsorbency, the adsorbent should have tunable pore size and allow for functionalization. There characteristics would create the highly selective material required for gas separation.

Previously our group introduced a new class of microporous hybrid materials called Microporous Organically Pillared Layered Silicates (MOPS). The synthesis of MOPS is eco-friendly, involving just a simple ion exchange of the organic cations (pillars) within synthetic layered silicates. These MOPS also feature “component modularity” and “functional porosity” meaning they maintain the intrinsic characteristics of their building blocks while also having new distinctive properties arise from their modification. This phenonomon gives MOPS huge potential as a gas separation material because they combines two key features for enhancing selectivity towards polarizable gases into a single structure:

1 - Incorporation of selectivity-enhancing groups by an easy pillar design approach

2 - Precise pore size tuning in the sub-Ångstrom range i.e. a tailored pore size fit for select adsorbates

Recently, we have demonstrated that MOPS are able to selectively recognize CO_2 from C_2H_2, or CO from N_2 by selective gate-opening processes (K. Bärwinkel, J. Am. Chem. Soc. 2017, 139, 904; M. M. Herling, Angew. Chem. Int. Ed. 2018, 57, 564). In ongoing studies, we are able to extend this static recognition behavior for use in the dynamic separation of gas mixtures by showing in breakthrough experiments that CO_2 could be selectively separated from CH_4 or N_2 by relying purely on physisorption. The future of this work includes the design and synthesis of new MOPS featuring high dynamic selectivity for industrially relevant gas mixtures. Additionally, we will apply the in-depth knowledge which we have gained from the synthesis of MOPS to the synthesis of permselective MOPS membranes.



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