METAL–ORGANIC FRAMEWORKS

Towards methane targets

Nat. Mater. **17**, 174–179 (2018)

Methane may be used as a transportation fuel but current gas-powered vehicles rely on high-pressure or low-temperature tanks to allow sufficient fuel to be stored on-board, which can be costly and unwieldy. Research efforts have therefore focused on porous materials such as metal–organic frameworks (MOFs) that can adsorb, store and release methane at more reasonable pressures and temperatures. While the capacities of many MOFs in powder form are promising, these typically have low packing densities when formed into densified pellets of the type required in an on-board tank, limiting their practical storage capacity. Now, David Fairen-Jimenez and colleagues in the UK and Spain prepare a densified, monolithic MOF with a capacity of 259 cm^3 of methane (at standard temperatures and pressures) per cm^3 of MOF at room temperature and 65 bar, virtually meeting the volumetric storage target set by the US Department of Energy (DOE).

The MOF the researchers use, HKUST-1, has previously been identified as potentially capable of reaching the DOE target, but attempts to pack and densify it resulted in a material with a 35% lower capacity than the theoretical maximum value, due to mechanical collapse of internal pore structures. The sol-gel synthesis that Fairen-Jimenez and colleagues develop circumvents this issue by growing the monolith directly and does not require high-pressure densification. In the initial step, particles of the MOF form within a wet gel structure. By drying the gel at ambient temperature, the MOF structure continues to grow, epitaxially, from retained precursors within the gel, binding together the primary particles to form the desired highly dense monolith. The researchers suggest that, based on previous computational models of methane storage, the capacity they achieve is close to the physical limit for methane storage within porous materials at ambient temperature.

James Gallagher

Published online: 5 February 2018
https://doi.org/10.1038/s41560-018-0100-9