GAS SEPARATION MEMBRANES

Vapour-phase fabrication

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Metal–organic frameworks (MOFs) are highly porous materials that can be used for the storage and separation of gases. For industrial application of MOF membranes, low cost and scalable synthesis methods are required. To that end, research is underway to fabricate MOF membranes using all-vapour-phase syntheses that may be more scalable and use less solvent than typical solution-based methods. Now, Kiwon Eum, Michael Tsapatsis and colleagues in the USA, South Korea and Japan demonstrate how the selectivity of MOF membranes for energy-relevant gas separations can be tuned using a vapour phase ligand treatment.

The researchers first prepare membranes of the MOF, ZIF-8, using an existing vapour phase method called ligand induced permselectivation. The ZIF-8 membranes are then exposed, at 180 °C, to a vapour of 2-aminobenzimidazole, which is incorporated into the MOF film. The researchers find that, for the gas pairs O_2/N_2, CO_2/CH_4, CO_2/N_2, H_2/CH_4 and H_2/N_2, the ideal gas selectivities of the treated membrane increase by around 2.5, 7, 9, 18 and 24 times, respectively. They propose that the improved selectivity for smaller molecules is due to the reduced pore size induced by incorporation of the 2-aminobenzimidazole. They also test their vapour phase ligand treatment on MOF membranes that have been made by a different method — rapid thermal deposition — and find that selectivity can also be improved in that system, suggesting that the technique may be more widely applicable.

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