

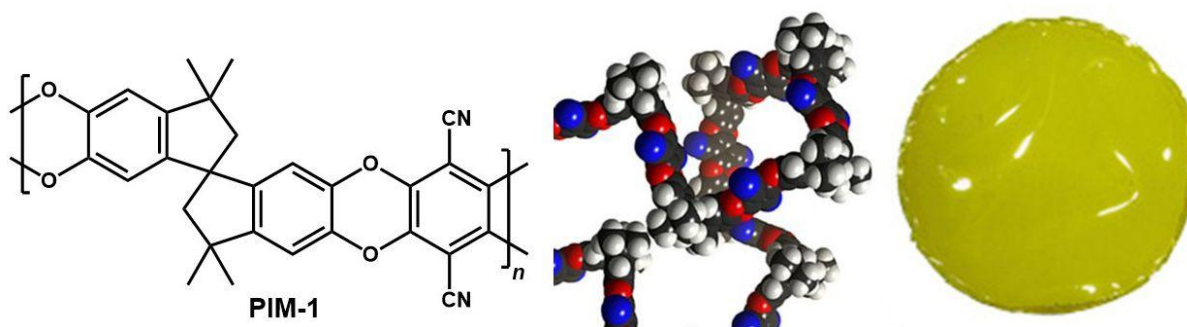
Polymers of Intrinsic Microporosity (PIMs) and their applications

Peter M. Budd

Department of Chemistry, University of Manchester

ABSTRACT

Polymers of intrinsic microporosity (PIMs) exhibit high free volume and behave like microporous materials (pore size <2 nm) because their rigid, contorted macromolecular backbones cannot pack together efficiently in the solid state. Since the first publications on solution-processible PIMs in 2004, there has been considerable research on this class of polymers and a wide variety of applications have been explored, including membranes for molecular separations. PIMs can be tailored for bespoke applications in various ways, including chemical modification and thermal or photo-oxidative treatment. The development of PIMs will be outlined and recent progress discussed.



Chemical structure of the prototypical polymer of intrinsic microporosity PIM-1, molecular model of a fragment of PIM-1, and a self-standing membrane formed of PIM-1

Membrane processes have a key role to play in a sustainable future, as they can be compact and energy-efficient compared to conventional separation processes. However, there is scope for improving the sustainability of the materials that are used; greener solvents are being explored for PIM synthesis. Membrane applications of PIMs have been constrained by concerns about the effects of physical ageing and plasticization. One way to improve long-term membrane performance is through the addition of fillers, however, poor compatibility between filler and polymer can be an issue. A key development is the recognition that, depending on the polymerization conditions, a PIM sample may contain a variety of polymer topologies, including branched, cyclic and network structures. The distribution of polymer topologies can have a profound impact on membrane performance and long-term behaviour. Recently the focus of much research has shifted to commercially realistic thin-film composite (TFC) membranes, rather than thick films. TFC membranes have been prepared in hollow-fibre form, as well as flat-sheet form.