Ultrahigh-permeance PIM-1 based thin film nanocomposite membranes on PAN supports for CO_2 separation

Rupesh S. Bhavsar, Tamoghna Mitra, Dave J. Adams, Andrew I. Cooper, Peter M. Budd

www.elsevier.com/locate/memsci

PII: S0376-7388(18)30930-X
DOI: https://doi.org/10.1016/j.memsci.2018.07.089
Reference: MEMSCI16368

To appear in: *Journal of Membrane Science*

Received date: 4 April 2018
Revised date: 4 July 2018
Accepted date: 30 July 2018

Cite this article as: Rupesh S. Bhavsar, Tamoghna Mitra, Dave J. Adams, Andrew I. Cooper and Peter M. Budd, Ultrahigh-permeance PIM-1 based thin film nanocomposite membranes on PAN supports for CO_2 separation, *Journal of Membrane Science,* https://doi.org/10.1016/j.memsci.2018.07.089

Ultrahigh-permeance PIM-1 based thin film nanocomposite membranes on PAN supports for CO_2 separation

Rupesh S. Bhavsar,[a1] Tamoghna Mitra,[b1] Dave J. Adams,[c*] Andrew I. Cooper,[b*] Peter M. Budd[a*]

[a]School of Chemistry, University of Manchester, Manchester M13 9PL, UK
[b]Department of Chemistry, University of Liverpool, Crown Street, Liverpool, Merseyside L69 7ZD, UK
[c]School of Chemistry, College of Science and Engineering, University of Glasgow, Glasgow, G12 8QQ, UK
Peter.Budd@manchester.ac.uk (Peter.M. Budd)
aicooper@liverpool.ac.uk (Andrew I. Cooper)
dave.adams@glasgow.ac.uk (Dave J. Adams)

[*]Corresponding author

Abstract

High permeance membranes were produced by addition of highly permeable nanoparticulate fillers (hypercrosslinked polystyrene, HCP, and its carbonized form, C-HCP) to a high free volume polymer (polymer of intrinsic microporosity PIM-1) in a thin film (typically 2 μm) on a porous polyacrylonitrile support. Self-standing mixed matrix membranes (MMMs) of thicknesses in the range 40–90 μm were also prepared with the same polymer and fillers. While robust MMMs could only be formed for moderate filler loadings, thin film nanocomposite (TFN) membranes could be produced from dispersions with filler loadings up to 60 wt%. On increasing the filler loading, CO_2 permeance increased in line with the predictions of the Maxwell model for a highly permeable filler. Physical ageing led to some loss of permeance coupled with an increase in CO_2/N_2 selectivity. However, for TFN membranes the greatest effects of ageing were seen within 90 days. After ageing, TFN membranes showed high permeance with reasonable selectivity; for example, with 60 wt% C-HCP, CO_2 permeance > 9,300 GPU, CO_2/N_2 selectivity ~ 11.

Graphical Abstract:

[1]These authors contributed equally to this work