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PII: S0376-7388(16)31066-3
DOI: http://dx.doi.org/10.1016/j.memsci.2016.11.074
Reference: MEMSCI14914

To appear in: *Journal of Membrane Science*

Received date: 21 July 2016
Revised date: 21 November 2016
Accepted date: 24 November 2016

Cite this article as: Jason Adams, Neha Bighane and William J. Koros, Pore morphology and temperature dependence of gas transport properties of silica membranes derived from oxidative thermolysis of polydimethylsiloxane, *Journal of Membrane Science,* http://dx.doi.org/10.1016/j.memsci.2016.11.074

# Pore morphology and temperature dependence of gas transport properties of silica membranes derived from oxidative thermolysis of polydimethylsiloxane

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## Abstract

Transport properties of silica membranes derived from the oxidative thermolysis of crosslinked polydimethylsiloxane (PDMS) were studied between 35°C-100°C. Changes in pore morphology and transport properties were investigated for varying thermolysis and crosslinking treatments. Permeation and pressure-decay sorption measurements were made for $CO_2$, $H_2$, He, $O_2$, $N_2$, and $CH_4$. Physisorption data for $CO_2$ and $N_2$ were also analyzed to characterize the pore size distributions of these materials. The activation energies of permeation and diffusion were measured along with the enthalpies of sorption to compare the effects of varying fabrication methods. All samples showed similar enthalpies of sorption. Regular and extended-thermolysis heat treated silica showed similar permeabilities and diffusion coefficients, but the heat treated silicas showed an average increase of 2.3 kJ/mol in their activation energies of permeation. The permeation, sorption, and diffusion selectivities of various gas pairs were compared. The silicas showed high sorption selectivity in gas pairs with large differences in critical temperature, but showed low diffusion selectivity due to low entropic selectivity. Overall, the PDMS-derived silicas show promise, but require further tuning to improve the entropic selectivity of penetrants.

## Keywords

Silica membranes; Polysiloxanes; Entropic selectivity; Temperature dependence; Gas separations

## Nomenclature

| | |
|---|---|
| $\alpha_{A/B}$ | Permselectivity between gases A and B (dimensionless) |
| $b_A$ | Langmuir affinity for gas sorption ($kPa^{-1}$) |