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PII: S0376-7388(16)30627-5  
DOI: <http://dx.doi.org/10.1016/j.memsci.2016.10.026>  
Reference: MEMSCI14812

To appear in: *Journal of Membrane Science*

Received date: 9 June 2016  
Revised date: 4 October 2016  
Accepted date: 16 October 2016

Cite this article as: Zhongde Dai, Luca Ansaloni, Douglas L. Gin, Richard D. Noble and Liyuan Deng, Facile fabrication of CO<sub>2</sub> separation membranes by cross-linking of poly(ethylene glycol) diglycidyl ether with a diamine and polyamine-based ionic liquid, *Journal of Membrane Science* <http://dx.doi.org/10.1016/j.memsci.2016.10.026>

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# Facile fabrication of CO<sub>2</sub> separation membranes by cross-linking of poly(ethylene glycol) diglycidyl ether with a diamine and a polyamine-based ionic liquid

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## Abstract:

In this study, a new family of poly(ethylene glycol) (PEG)-based membranes for CO<sub>2</sub> separation was developed using PEG diglycidyl ether (PEGDE) cross-linked with a low-molecular-weight diamine (2,2'-(ethylenedioxy)bis(ethylamine)) and a polyamine-based ionic liquid (triethylenetetramine trifluoroacetate, [TETA][Tfa]) in a solvent-free process. A mass fraction up to 80% PEG dimethyl ether (PEGDME, average  $M_n \sim 250$ ) was added to the cross-linked matrix to enhance the gas transport properties. The cross-linking reaction mechanism, thermal stability of the resulting membranes, as well as water uptakes of the formed membranes were systematically investigated. The CO<sub>2</sub>, N<sub>2</sub>, and CH<sub>4</sub> gas transport properties of these new membranes were studied. Both CO<sub>2</sub>/N<sub>2</sub> and CO<sub>2</sub>/CH<sub>4</sub> binary mixed gas separation performances of the membranes at various humidity levels were tested. The gas permeation results showed that the free PEGDME additive acts as plasticizer in the polymeric matrix, resulting in excellent CO<sub>2</sub>/N<sub>2</sub> and CO<sub>2</sub>/CH<sub>4</sub> separation properties.

## Key words

Poly(ethylene glycol); cross-linking; ionic liquids; CO<sub>2</sub> separation

## Nomenclature

|                                   |                                                                                         |
|-----------------------------------|-----------------------------------------------------------------------------------------|
| $P$<br>$s^{-1} \text{ cmHg}^{-1}$ | Gas permeability (barrers, 1 barrer= $10^{-10} \text{ cm}^3 \text{ (STP) cm cm}^{-2}$ ) |
| $D$                               | Gas diffusivity ( $\text{cm}^2 \text{ (STP) /cm}^2 \text{ polymer cmHg}$ )              |
| $S$                               | Gas solubility ( $\text{cm}^3/\text{s}$ )                                               |

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