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# Facile fabrication of $CO_2$ 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 $CO_2$ 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 $M_n$ ~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 $CO_2$, $N_2$, and $CH_4$ gas transport properties of these new membranes were studied. Both $CO_2/N_2$ and $CO_2/CH_4$ 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 $CO_2/N_2$ and $CO_2/CH_4$ separation properties.

**Key words**

Poly(ethylene glycol); cross-linking; ionic liquids; $CO_2$ separation



## Nomenclature

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