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Enhancement of CO_2 capture by polyethylene glycol-based polyurethane membranes

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Abstract

Poly (ethylene glycol) (PEG)-based polyurethane (PU) membranes are attractive materials for CO_2 separation from various sources such as flue gas and syngas. However, the strong tendency of PEG chains to crystallize can lead to reduced permeability of the membrane. Here, we developed new types of PU chemistries with high PEG content and reduced crystallinity. A series of PUs were synthesized based on mixtures of PEG and poly (propylene glycol) (PPG), and various PEG-PPG triblock copolymers (PEG-b-PPG). The presence of PEG-b-PPG triblock copolymers combines the high selectivity of PEG while the PPG pendant methyl group hinders local crystallization. The resulting membranes showed CO_2 permeability of 144 barrer and high CO_2/N_2 and CO_2/H_2 selectivities up to 54 and 8.3, respectively. Due to the absence of a crystalline soft phase, synthesized PUs with PEG-b-PPG triblock copolymers exhibit higher chain flexibility which is reflected by a decrease in the glass transition temperature of the soft segment. In contrast, the mixture of PEG and PPG showed minimal effects on the crystallinity of PEG domains. This resulted in lower membrane gas separation performance where CO_2 permeability and CO_2/H_2 selectivity decreased to 68 barrer and 4.9, respectively.

Keywords: Polyurethane, gas separation, CO_2 capture, poly (ethylene glycol)