Performance of Supported Ionic Liquid Membranes for CO_2/N_2 Separation

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Ionic liquids are bulky salts that are liquid at room temperature. They have received interest for their unique electrochemical properties, high chemical and thermal stability, and widely varying absorption rates for different gases. Supported Ionic Liquid Membranes (SILMs) are particularly promising for their possible applications in carbon sequestration. Due to the high solubility of CO_2 and low solubility of N_2 in many ionic liquids, SILMs could be used to separate CO_2 from stack gas. This study used SILMs prepared by coating porous anodic alumina substrates of two different pore sizes and orientations with two different ionic liquids of interest. The pressure over time of target gases (CO_2 and N_2) was measured and a transient mass transfer experimental method was used to determine the permeance of each.

1,3-dibutylimidazolium bis(trifluoromethylsulfonyl)imide ([Bbim][Tf_2N]), a relatively unstudied ionic liquid, was tested to determine whether alumina membranes of different pore sizes yielded a statistically significant change in permeance and ideal CO_2/N_2 permselectivity. 1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ([Emim][Tf_2N]) was tested with different pore sizes in the reversed orientation and compared to previous studies on a regular orientation to determine if different orientations and pore sizes yielded a statistically significant change in permeance and ideal CO_2/N_2 permselectivity. Experiments proved in both cases that there was no statistically significant change. When plotted on a "Robeson plot", the SILMs approached the "upper bound" for permeance and ideal CO_2/ N_2 permselectivity and were comparable to other similar ionic liquids.