Crosslinked High Performance Polymeric Membranes for CO_2 Removal from Flue Gas

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Research Goals

• We aim to develop novel Crosslinked High Performance Polymeric Membrane materials to be applied in CO_2 capture from flue gas streams. Highly aromatic, crosslinked polymers are chemically resistant and thus durable for handling flue gas. However, existing materials do not possess high enough CO_2 permeability. Our goal is to explore modifications to existing polymer structures, such as inclusion of fluorinated groups, to yield a membrane that is highly permeable to CO_2.

Research Contents

• In the first year of this project, we will investigate many variations to the chemical structure of the monomers such as inclusion of bulky groups to disrupt polymer chain packing and increase free volume, and variation of the density of activating and/or methyl groups to affect the degree of crosslinking. CO_2, N_2, and water vapor permeability will be measured for each material. Materials will be tested for thermal, chemical and mechanical durability. Samples will be exposed for prolonged periods of time to water vapor at 120°C and 2 atm in order to simulate the aggressive conditions of flue gas. After exposure, films will be characterized for changes in permeability, selectivity, chemical structure, and mechanical strength. The results of these tests will provide guidance for further refinements of the chemical structure, and ultimately will yield a small number of the best performing materials in terms of durability and CO_2 flux.

Expected Effects

• Membranes produced from materials identified in this study could be applied to post-combustion CO_2 capture processes. We expect the materials to exhibit high CO_2 permeability (in excess of 300 Barrer), high CO_2/N_2 selectivity (in excess of 20), and excellent thermal and chemical durability under conditions typical of flue gas environments.