DEVELOPMENT OF NANOCOMPOSITE MEMBRANES FOR CO_2 CAPTURE

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ABSTRACT
Global warming is a major environmental issue for the world, and in order to reduce greenhouse gas emission by the capture of carbon dioxide from flue gas, different technologies are being developed. In post combustion, one of the important techniques in CO_2 capture, flue gas is passed through equipment which separates or captures most of the CO_2. To date, there are several post combustion gas separation and capture technologies being investigated. Due to their economical and environmental advantages, a lot of research activities are being carried out for development of sophisticated membrane materials such as facilitated transport membranes, polymeric, inorganic and mixed matrix materials for CO_2 capture. When used in industrial applications the membrane will need to be chemically resistant to the sometimes harsh chemical components in flue gas, and some pretreatment may be needed in order to remove these impurities. Many studies have shown that polymeric inorganic filler composites exhibit improved selectivity and high permeability in gas separation applications. Based on Robeson reporting, the performance of polymers is limited by an upper-bound trade-off line, which demonstrates a strong inverse relationship between the aforementioned parameters: permeability and selectivity (polymers that are more permeable are commonly less selective and vice versa). While inorganic membranes have been shown endure high stability under high temperature and harsh physical and chemical conditions, their gas separation properties are usually not so good. They also have costly manufacturing processes. In contrast, the polymeric membranes may demonstrate moderate separations under the upper-bound Robeson curve, but lower cost, easy manufacturing and higher mechanical properties. The newer nanocomposite membranes which consist of inorganic filler embedded in a polymeric matrix, have shown to be able to overcome the limitations established by Robeson, while still maintaining the mechanical flexible properties of the polymeric matrix.

In the current work a novel hybrid nanocomposite membrane will be developed. Synthesis of a hybrid nanocomposite membrane will be performed by incorporating various types of nano particles in unstructured polymer matrices. The nanoparticles will affect the free volume of the polymer material, and thus enhance the separation properties. Stability over time of the polymeric nano composites will be investigated in order to meet the operational conditions under which such membranes could be most efficient. The permeation properties of selected membranes will be documented for some single gases (N_2, O_2, CO_2), and relevant mixtures on laboratory scale. The effect of some harsh chemical components present in industrial gas streams will be documented. Then optimizing the membranes with respect to performance for flue gas separation will be the next step. Characterization of the developed polymeric nano composite membranes will be performed before and after exposure to gases at various temperatures and pressures in order to check their durability.
The chosen procedures and material selection for development of these nanocomposites will be detailed out in the presentation.

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