CO_2 Capture by Polymeric Membranes: Challenges for Demonstration

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Various CO_2 separation membranes have been developed, and polymeric membranes hold potential for large scale CO_2 capture in terms of synthetic feasibility, large-scale productivity, and processability. In this laboratory, amines have been incorporated into polymeric membranes to enhance the CO_2 transport properties, especially for pre-combustion CO_2 capture at an integrated gasification combined cycle plant, where CO_2 is separated over H_2.[1] Alkanol amines having hydroxyl group, such as 2-(2-aminoethylamino)ethanol, show excellent CO_2 separation performance in a polymer matrix, and the mechanism of preferential CO_2 permeation have been elucidated. The separation properties are significantly increased under highly humidified conditions. CO_2 partially becomes HCO_3^- and migrates through the polymeric membranes. The amine-containing polymeric membranes also exhibit very high CO_2 separation performance over N_2 and CH_4.

Recently, facile preparation of a hollow-fiber membrane module was developed by an *in-situ* modification method for pilot-scale demonstration.[2] A CO_2-selective layer is formed on a lumen side of commercial hollow-fiber membranes by circulating aqueous membrane material solution through the modules for several minutes as shown in Figure 1. This preparation allows scale-up of membrane area, which is one of the most important points to utilize for CO_2 capture. In this presentation, optimization of the preparation conditions and a possible separation process will be introduced.

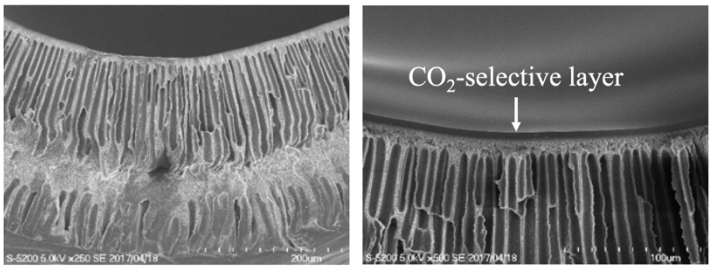

Figure. Cross sectional SEM images of hollow fiber membrane before (left) and after (right) in-situ modification

Beside pre-combustion CO_2 capture, the membranes would be utilized for carbon-free H_2 production from biogas. The preliminary results of biogas-upgrading by the resulting membrane modules are also discussed.

1. For example, Taniguchi, I., "Poly(amidoamine) Dendrimers for Carbon Capture" in *Materials for Carbon Capture*, Jiang, D., Mahurin, SH, Dai, S., Eds., Wiley, 2020.
2. Duan S., Kouketsu, T., Kazama, S., Yamada, K., "Development of PAMAM dendrimer composite membranes for CO_2 separation", *J. Membr. Sci.*, 283, 2, 2006.