CO_2 capture by membranes and the perspectives

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One of the feasible methods to mitigate CO_2 emission must be CO_2 Capture & Storage (CCS), and effective CO_2 capture technologies have been investigated, which account for a majority of the CCS cost. Membrane separation would be suitable for CO_2 capture in terms of energy consumption, footprint and cost in comparison to current CO_2 capture technology, liquid amine scrubbing. CO_2 separation over H_2 by polymeric membranes has been studied in this research group for pre-combustion CO_2 capture at an integrated gasification combined cycle plant. The mechanism of preferential CO_2 permeation was elucidated as shown in Fig. 1. Under humidified conditions, CO_2 turns to bicarbonate ion, which is the major migrating species through the membrane. When the amines have hydroxyl groups, a seven-membered ring is formed to facilitate bicarbonate ion production upon hydrolysis. The resulting polymeric membranes show high CO_2 permeability even under pressurized conditions.

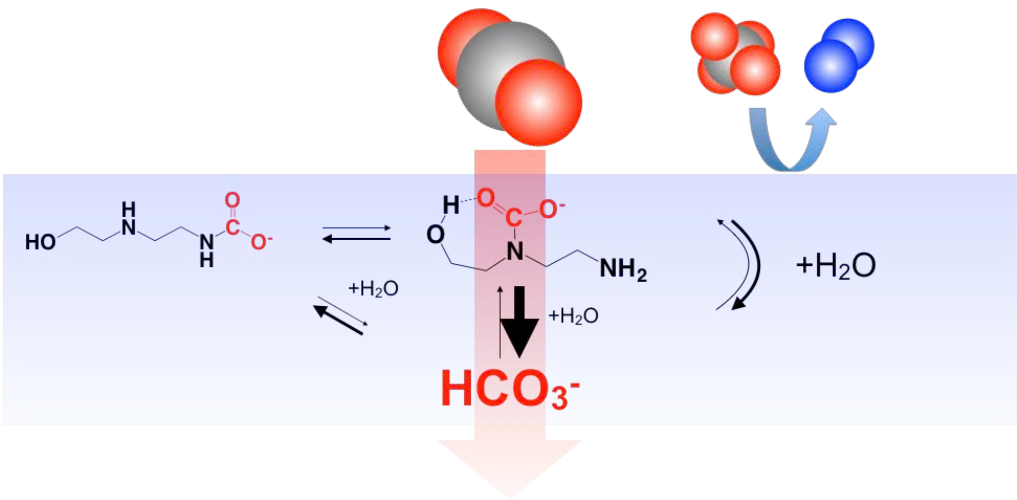

Fig. 1. Schematic drawing of CO_2 permeation mechanism through 2-(2-aminoethylamino)ethanol-containing polymeric membranes under humidified conditions.

For pilot-scale demonstration of the CO_2 separation membranes developed, membrane modules should be prepared by the "*in-situ* modification (IM)" method. A thin CO_2 separation (or active) layer is formed on inner surface of hollow fibers by passing through the membrane material solutions. The IM method is scalable, and the resulting hollow-fiber membrane modules also display excellent CO_2 separation performance over H_2, N_2, and CH_4.