The Preparation and Characterization of Hydrotalcite Membranes

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CO₂ emissions are thought to be responsible for global warming. In order to solve this problem, CO₂ must be separated out of the flue-gas and sequestered. CO₂-selective inorganic membranes are useful for that purpose, and have been prepared as part of this study. Hydrotalcites (HT), also known as layered double hydroxide compounds, are potentially good candidate materials as CO₂-selective membranes due to their desirable properties [1, 2]. Therefore, the purpose of this study is to prepare effective CO₂-selective HT membranes, and to understand the transport of gases through them. Several methods have been used in our study for the synthesis of the HT membranes. We prepared two different types of membranes, namely large-area membrane (disks and tubes), and micro-membranes prepared on stainless steel sheets; the permeation characteristics of single gases and mixtures of gases in these membranes have been studied.

The HT membranes have also been characterized using analytical methods such as SEM, XRD, and BET. Most of the membranes prepared are mesoporous. However, microporous membranes have also been prepared using the electrophoretic deposition (EPD), and vacuum suction methods. During EPD, positively charged HT colloidal particles migrate to the membrane support surface to form uniform, thin membrane films [3]. EPD membranes show slight selectivity towards CO₂ in both single and mixture gas experiment. Vacuum-suction HT membranes were shown to have He/CO₂ permselectivity that was significantly higher than the corresponding Knudsen value; however, these membranes are not CO₂-permselective. In order to decrease voids and pinholes of these membranes, a silicone layer is coated on their surface by vacuum suction. The best CO₂-permselective membrane exhibits CO₂ permeance of 8.33×10⁻¹⁰ [mol/m²s Pa], with a CO₂/N₂ separation factor of 34.4 and CO₂/He separation factor of 12.4 respectively. The HT micro-membranes are also shown to be microporous transporting gases according to their kinetic diameters, in the order He>CO₂>Ar.

References