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Green Delamination of 2D LDH Nanosheets Incorporated in Mixed Matrix Membrane for CO_2 Capture

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Abstract

Global warming has been concerned for several decades, which results in severe damage to the earth. In order to protect the environment, carbon capture is imperative. Among diverse methods to reduce CO_2, membrane technology is the most attractive because of its low energy consumption. Compared to polymeric membranes and inorganic membranes, mixed matrix membranes combine their benefits, being promising materials in the future.

Layered double hydroxide (LDH), which comprises exchangeable anions within the positively charged brucite-like layer, has been employed as an adsorbent and catalyst in the past. However, it is rarely used in membranes. In this study, we graft the amino silane onto the surface of LDH while simultaneously exchanging the interlayer anion for the sodium dodecyl sulfate. Then we incorporated modified-LDH into Pebax-1657 with polyethylene glycol dimethyl ether (PEGDME) as an additive to fabricate mixed matrix membrane which is applied in carbon capture.

Due to the increased free volume caused by PEGDME and the delaminated LDH, CO_2 passes through the membrane more quickly and endows the membrane with high performance of CO_2 separation. The optimal performance can be obtained by adding 50% PEGDME and 4% LDH-based materials into Pebax-1657, exhibiting CO_2 permeability and CO_2/N_2 selectivity with 460 Barrers and 63, respectively. Furthermore, no toxic solvent was used in the process, providing a environmentally friendly method to fabricate MMM applied in CO_2 capture. This research's innovative breakthrough provides excellent prospects.

References

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