

CO₂ as a Co-guest of Structure H (sH) Hydrates Formed from CO₂ + N₂ +
Methylcyclopentane (MCP) + Water Mixtures

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In this study, the thermodynamic behaviors, storage capacity, and structural transition of the CO₂ + N₂ + MCP hydrates were investigated for their potential applications in hydrate-based CO₂ capture and sequestration. sH hydrates can capture large-sized liquid hydrocarbon as guests in the presence of help gases such as CH₄, Xe and N₂. However, a controversy arose from the fact that CO₂ functions as a co-guest molecule to form sH hydrate. In order to resolve the controversy, the four-phase equilibria of the CO₂ + N₂ + MCP+ water mixtures were measured and compared with the three-phase equilibria of the corresponding CO₂ + N₂ + water mixtures to investigate the enclathration of CO₂ as a co-guest in sH hydrates. In addition, Raman spectroscopy and powder X-ray diffraction (PXRD) were used to verify the structural transition. Also, hydrate composition and gas consumption experiments were conducted to measure the gas storage capacity of the CO₂ + N₂ + MCP hydrates. From these results, we confirmed that CO₂ can act as a co-guest of sH hydrates and the structural transition from sH to sI occurs in N₂-rich systems.