CO_2 as a Co-guest of Structure H Hydrates Formed from the CO_2 + N_2 + 2,2-dimethylbutane + Water Mixtures

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Natural gas hydrates are regarded as a future clean energy source. The CH_4-flue gas replacement in naturally occurring gas hydrates has been recently suggested for the CO_2 sequestration and CH_4 recovery. In spite of the predominance of structure I (sI) and structure II (sII) hydrate reservoirs in nature, it was reported that struecture H (sH) hydrates also naturally occur. For the CH_4-flue gas replacement based on sH hydrates, it is important whether CO_2 functions as a co-guest in sH hydrates and enclathrated CO_2 affects structural transition in terms of CO_2 sequestration. In this study, the effect of sH hydrate formation on the three-phase (H-Lw-V) equilibria of the mixed gas hydrate was investigated. The structures of these hydrates were analyzed to ensure the enclathration of CO_2 in sH hydrates and to verify structural transition sH into sI hydrate via Raman spectroscopy, X-ray diffractometry (XRD) and differential scanning calorimetry (DSC). The CO_2 hydrate compositions were measured via gas chromatography to determine the CO_2 storage capacity. From these experiments, it was verified that CO_2 functions as a co-guest of sH hydrate in the N_2-enriched system, and structural transition of sH to sI occurs in the CO_2-enriched system.