

Structural and thermodynamic behaviors of natural gas hydrates containing large molecule guest substances (LMGSs)

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Natural gas hydrates (NGHs) are formed at high pressure and low temperature conditions and expected as one of future clean energy sources. Gas hydrates exist in three different structures; sI, sII, and sH. Some NGHs were identified as sH in the presence of large molecule guest substances (LMGSs). On the other hand, previous research reported that LMGSs could act as thermodynamic inhibitors of gas hydrates even though they do not have any functional groups for inhibition. In addition, the phase behavior and structural coexistence of NGHs containing LMGSs have not been well studied. In this study, neohexane and methylcyclopentane were selected as LMGSs for the CH₄ (90%) + C₃H₈ (10%) hydrate. The four-phase (H-L_W-L_{LMGS}-V) equilibria were measured to verify the accurate role of LMGSs in the CH₄ (90%) + C₃H₈ (10%) hydrate. The structure and guest distributions of gas hydrates containing LMGSs were analyzed using ¹³C NMR and PXRD. Furthermore, the dissociation pattern of CH₄ (90%) + C₃H₈ (10%) + LMGS hydrates were also observed using in-situ Raman spectroscopy and gas chromatography.