

Accurate phase behavior and structural identification of natural gas hydrates containing large molecule guest substances (LMGSs)

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Natural gas hydrates (NGHs) are crystalline compounds that formed at high pressure and low temperature and are regarded as one of future clean energy resources. Gas hydrates exist in three different structures; sI, sII, and sH. Structure of NGHs were known to exist in sI and sII, but it was recently revealed that NGHs also exist in sH in nature when large molecule guest substances (LMGSs) are involved. On the other hand, previous research reported that LMGSs could act as thermodynamic inhibitors of gas hydrates even though LMGSs don't have any functional groups for inhibition like a hydroxyl group. In addition, accurate phase behavior and structural coexistence of NGHs containing LMGSs have not been studied well. In this study, neohexene (NH) was selected as LMGS for CH₄ (90%) + C₃H₈ (10%) and CH₄ (90%) + C₂H₆(10%) hydrates. To verify the role of NH, the four-phase (H-LW-LNH-V) equilibria were first measured. The guest distributions and compositions of gas hydrates containing NH were analyzed using ¹³C NMR and PXRD. In addition, the dissociation patterns of gas hydrates containing LMGS were also observed using *in-situ* Raman spectroscopy.