Experimental Verification of the CH4 -Flue Gas Replacement in the Structure H Hydrate System



The CH_4 -flue gas replacement in naturally occurring gas hydrates has attracted great attention 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 also reported that structure H (sH) hydrates naturally occur. For the application of CH_4 -flue gas replacement in the sH hydrate reservoirs, the replacement mechanism is significantly important. In this study, stability condition shifts of initial and replaced hydrates were verified that flue gas was successfully replaced with the CH_4 in the sH hydrates. The structural transition of the replaced hydrate was investigated via NMR, Raman spectroscopy, X-ray diffractometry (XRD) and high pressure micro differential scanning calorimetry (HP μ -DSC). To examine the thermal properties, dissociation enthalpies of the initial CH_4 + 2,2-dimethylbutane hydrates and replaced hydrates were measured using a HP μ -DSC. In addition, the heat flow changes during the replacement process were monitored to observe the heat generated or absorbed due to dissociation, formation, and swapping. This study reveals the stability conditions, structural transition, and thermal properties of the CH_4 -flue gas replacement in the sH hydrate reservoirs.