# Experimental Verification of $CH_4$-Flue Gas Swapping by Thermal and Microscopic Analyses

이요한, 김연주, 이재형[1], 서용원*
울산과학기술대학교; [1]한국지질자원연구원
(ywseo@unist.ac.kr*)

Naturally occurring $CH_4$ hydrates have promising potential as a possible new clean energy source and appropriate materials for sequestering $CO_2$. Research has been recently conducted on the injection of flue gas, which consists mainly of $CO_2$ and $N_2$ into these natural gas reservoirs. Using this method, $CO_2$ is able to be stored without separating stage, and a new energy source is more effectively exploited. For this method, thermodynamic properties of $CH_4$-flue gas swapping are critical factors for the application of the swapping process. This study is mainly focused on measuring dissociation enthalpy of mixture of $CO_2$ and $N_2$ hydrates, and $CH_4$ hydrates swapped by mixture of $CO_2$ and $N_2$ using differential scanning calorimetry (DSC). In order to decide on the proper experimental conditions, three-phase (H-Lw-V) equilibrium points of gas hydrates are measured at various compositions. Each gas hydrate related to this process is also analyzed via NMR spectroscopy, Raman spectroscopy and X-ray diffractometry (XRD) to determine the effect of swapping on the hydrate structure. From this study, the feasibility of $CH_4$-flue gas swapping is revealed in terms of thermodynamic analysis.