Thermodynamic and structural characteristics of the N_2 + CHF_3 and N_2 + C_2F_6 gas hydrates for hydrate-based F-gas separation

김은애, 진영근[1], 서용원†
울산과학기술대학교; [1]극지연구소
(ywseo@unist.ac.kr†)

The emission of CHF_3 and C_2F_6 to the atmosphere should be reduced in order to mitigate the accelerating global warming effect. To examine the feasibility of the gas hydrate-based F-gas capture, the N_2 + CHF_3 and N_2 + C_2F_6 gas hydrates were investigated with a primary focus on macroscopic thermodynamic conditions, microscopic structural analyses, and gas separation efficiency. The H-L_W-V equilibrium lines of both N_2 + CHF_3 and N_2 + C_2F_6 hydrates were shifted to thermodynamically more stable region as the concentrations of F-gases increased when compared to pure N_2 hydrate. The N_2 + CHF_3 hydrates were revealed to be sI hydrates, whereas the N_2 + C_2F_6 hydrates were found to be sII hydrates through powder X-ray diffraction. Also, the formation process of both N_2 + CHF_3 and N_2 + C_2F_6 hydrates was monitored using in-situ Raman spectroscopy. Lastly, the efficiency of gas separation was examined through gas chromatography by measuring gas compositions of both vapor and hydrate phases after the completion of hydrate formation.