

Structure Identification and Thermodynamic Stability of Mixed CHF₃ + N₂ Gas Hydrates

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CHF₃ (fluoroform, HFC-23), one of the most common F-gases, is primarily used as a useful refrigerant or used in the semiconductor industry. However, because of its significant global warming potential that is 11700 times higher than that of CO₂, the effective method to prevent the release of CHF₃ into the atmosphere should be established. To solve this problem, gas hydrate-based CHF₃ capture was suggested as one of the solutions. In this study, the thermodynamic and structural properties of the mixed CHF₃ + N₂ gas hydrates were investigated with a primary focus on macroscopic phase behaviors and microscopic analyses. The three-phase (gas hydrate (H) – liquid water (L_w) – vapor (V)) equilibria of the mixed CHF₃ + N₂ gas hydrates were measured at different CHF₃ concentrations (10, 20, 40, 60, 80, and 100 %). As the concentration of CHF₃ decreases, the three-phase equilibria were inhibited. The accurate structures of the mixed CHF₃ + N₂ gas hydrates were identified through powder X-ray diffraction, and further verified using ¹³C NMR and ¹⁹F NMR. The results from this study are expected to be helpful in understanding and developing a CHF₃ capture process using gas hydrate formation.