

## Spectroscopic Observation of Tuning Pattern and Phase Equilibrium Measurements Composed of New sII Hydrate Formers

박성민, 신웅철, 노혜윤, 이 혼\*

KAIST

(hlee@kaist.ac.kr\*)

Clathrate hydrates are non-stoichiometric crystalline compounds formed by physically stable interactions between water and small guest molecules. There are three common structures of clathrate hydrates termed structure I, II and H. In this work, we suggest two new amine-type compounds, pyrrolidine and piperidine, as new sII clathrate hydrate formers. First, we presented spectroscopic results about (pyrrolidine + methane) and (piperidine + methane) hydrates using NMR and Raman microscope which show hydrate structure and distribution of methane gas molecules over sII-S and sII-L cages. In particular, we endeavored to confirm the occurrence of a tuning mechanism at pyrrolidine concentration that are much lower than a stoichiometric concentration 5.56 mol%. The XRD patterns were also analyzed to find the exact structure and corresponding cell parameters. Finally, we measured the hydrate phase equilibria of (pyrrolidine+ methane) and (piperidine+ methane). This discoveries can be extended to other amine-related guest species with the specific modification and provide new insights on gas storage.