

Structure transition in the double ($H_2 + (CH_3)_4NOH$) ionic clathrate hydrate

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We observed an extraordinary structural transition in the double ($H_2 + (CH_3)_4NOH$) ionic hydrates system. The peculiar structure transformation of ionic hydrate was investigated by solid-state 1H NMR spectroscopy. The incipient signal shift of the host lattice is observed in the $(CH_3)_4NOH \cdot 9 H_2O$ sample. The H_2 peaks representing sI-S ($\delta = 4.1$ ppm) first appear, but under more hydrated surroundings the H_2 peaks representing sII-S ($\delta = 4.3$ ppm) are newly detected, confirming the coexistence of two different sI and sII double ($H_2 + (CH_3)_4NOH$) ionic clathrate hydrates. It is important to that the sI phase only contains the double ionic clathrate hydrate, eliminating any possible formation of the pure hydrogen clathrate hydrate under the present experimental condition. The microscopic analyses of ionic clathrate hydrates that seek to identify physicochemical characteristics are expected to provide new insights into inclusion chemistry fields.