

Nucleation Mechanisms of Hydrate Reflected by Gas Dissolubility

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Gas concentration has been confirmed as the key factor dominating hydrate nucleation. CO₂ hydrates were formed in pure water and SDS solution using a temperature decreasing method under constant pressure at different temperatures. The dissolving properties of CO₂ throughout the whole induction period were investigated in detail. The experimental results show that the 'memory effect' of a hydrate might not be attributed to the residual water structures after hydrate dissociation. Instead, the residual gas molecules in the aqueous phase should be paid more attention to. With the consumed amounts of gas during the temperature decreasing period, the hydrate nucleation is confirmed as a kind of chain reaction. Low temperature is also a significant factor promoting hydrate nucleation. Finally, these two factors enhance the stochastic feature of the hydrate nucleation reaction. The critical gas concentrations beyond which hydrates can nucleate spontaneously are not fixed even under the same experimental condition and present an obvious linear relation to the specific experimental temperature. Considering the significant influences of temperature on the dissolving properties of gas, a new nucleation mechanism of hydrate from the point of view of the reaction system's potential was established, providing some new light on explaining the formation reason of gas hydrates in natural reservoirs.