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CH4/H2O Competitive adsorption in Nano porous materials under clathrate hydrate formation conditions

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In this study, we delve into the intricacies of gas adsorption behavior within nanoporous materials, specifically focusing on the competitive adsorption of CH4 and H2O molecules under clathrate hydrate formation conditions. We aim to elucidate how the presence of water or humidity affects the total gas adsorption capacity of these materials.

Under low-temperature hydrate formation conditions, water tends to transform into gas hydrate crystals, thereby enhancing the overall gas storage capacity. However, this transformation process is far from straightforward and is heavily influenced by the properties of the nanoporous material, including its hydrophobicity, pore size, and surface chemistry. These material characteristics play pivotal roles in dictating the kinetics, overall storage capacity, and thermodynamics of the hydrate formation process.

To comprehensively examine CH4 gas storage and the competitive interactions with H2O molecules, we conduct a series of high-pressure reactor experiments. These experiments are designed to generate gas isotherms at low temperatures (1-2℃) across varying water saturation levels. Our primary focus is on understanding the profound impact of hydrophobicity and surface chemistry on the formation process within this hybrid system. Finally, we compare our results with those obtained from a bulk water system to affirm the synergistic effects of nanoporous materials on gas storage behavior.

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