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**Understanding the characteristic of methane hydrate equilibrium in materials  
and its potential application**

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**ABSTRACT.** Understanding the phase characteristic of methane hydrate in materials is of recent interest in several fields. In this study, methane hydrate dissociation conditions in nine water wetted porous materials (ZIF-8, MIL-53(Al), HKUST-1, nonporous activated carbon, zeolite 13X, and four silica gels) with pore diameters ranging from 0.35 to 100 nm as well as in two nonporous quartz sands were systematically investigated. The adsorption properties of methane in some selected adsorbents were also studied. For microporous materials, our results confirmed that methane hydrate cannot form due to the size limitation for the nucleation of a methane hydrate crystal. In contrast, for mesoporous materials with a pore diameter of 6.2 nm or bigger, hydrate formed in their pores and significantly shifted dissociation temperatures and pressures compared to the bulk hydrate were observed. The largest temperature shift was found to be ~6 K in materials possessing 6.2-nm-diameter pores, and this shift decreased to less than 1 K in structures having 45-nm-diameter pores. For macroporous materials with a pore diameter of 100 nm or for nonporous quartz systems, the influence of pore sizes on the methane hydrate phase equilibrium was

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