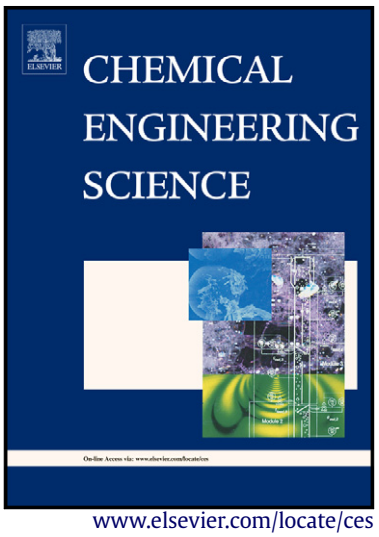

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Hydrate Formation in Layers of Gas-Saturated Amorphous Ice

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Abstract

Layers of amorphous ice saturated with methane, ethane, propane and carbon dioxide were obtained by condensation of molecular beams of rarefied vapor and gas on a substrate cooled with liquid nitrogen. The amorphous state of such objects at low temperatures is stabilized by the high viscosity and the small value of the stationary nucleation rate of the crystal phase. Their heating in condition of high metastability is accompanied by spontaneous explosive crystallization, which leads to the formation of gas hydrates. Glass-transition and crystallization temperatures were determined by changes in their dielectric properties under heating. An increase in the gas content in layers of amorphous ice causes an increase in the crystallization temperature without any significant changes in the glass transition temperature. At atmospheric pressure in a liquid n-pentane medium the retention of gas hydrates was observed up to temperatures close to 273 K. Self-preservation ensured the retention of hydrates in a metastable state at temperatures exceeding considerably their equilibrium dissociation temperatures. Samples of gas hydrates obtained at a maximum gas flow rate during the deposition contained up to 15 mass % of methane, 12 mass % of ethane, 13 mass % of propane, and 23 mass % of carbon dioxide.

Keywords: Phase transformation; Gas hydrate; Hydrocarbons; Carbon dioxide; Amorphous ice

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