

Gas hydrate inhibition by disrupting the water structure for pipeline flow assurance

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Gas hydrates are crystalline materials which contain gases in hydrogen bonded water lattice. In spite of their potential as clean energy resources and in practical applications, a lack of understanding on hydrate formation and inhibition hinders their use. The perturbation of the water structure by solutes has been proposed to be a key process in hydrate inhibition, but this has not yet revealed by experimental evidences. Here, we report the direct observation of perturbation of the water structure induced by amino acids using polarized Raman spectroscopy, and its effects on the gas hydrate kinetics. Amino acids with hydrophilic and/or electrically charged side chains disrupted the hydrogen bond network of water molecules and thus offered better hydrate inhibition performances. The strong correlation between the extent of water structure perturbation by amino acids and their inhibition performance greatly support the perturbation inhibition mechanism. Our present findings would be helpful for the enhanced management of hydrates and the development of related applications.