Synergism in thermodynamic promotion of cyclopentane (CP) and tetrahydrofuran (THF) on CH_4 hydrate

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Gas hydrates are crystalline compounds that encapsulate gas molecules at harsh conditions and have the potential for gas storage and transportation. However, the harsh conditions for gas hydrate formation pose some problems of high process cost. Therefore, thermodynamic promoters such as CP and THF are required to shift hydrate formation coditions to mild regions. Recently, it was reported that the thermodynamic promotion synergy could occur when CH_4 hydrate formed in the presence of both CP and THF. However, CP and THF have competitive relationship in occupying hydrate cages and their accurate cage-filling behavior remains unclear. In this study, the thermodynamic promotion synergy of CP and THF on CH_4 hydrate was investigated. The cage occupancy of the CH_4 + CP + THF hydrates was analyzed via ^{13}C NMR. The PXRD patterns of the CH_4 + CP + THF hydrates were analyzed using FullProf program. CH_4 + CP + THF hydrates were found to be cubic sII and both CP and THF occupied large cages of sII. The results indicated both CP and THF enclathrated in the hydrate cages and thermodynamically promoted CH_4 hydrates synergistically.