

# **Thermostimulated transitions in thin cryovacuum deposited films of the two-component $\text{CH}_4+\text{H}_2\text{O}$ mixture**

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Stable homogenous states of aqueous hydrocarbon solutions may only be observed at high temperatures and pressures extending beyond the critical region of the components. Upon transition of the two-component system into the region of super-cooled (metastable) states, with low values of thermodynamic variables, homogeneity may be preserved together with internal stability. This work is the result of structure-phase equilibria studies of the two-component water-methane system in the region of metastable states of co-existing phases. In such systems the region of metastable states is thermodynamically analogous to structure forming conditions in single-component systems [1].

Vapor mixtures of water and methane with various ratios deposited under strongly metastable non-equilibrium conditions onto a cooled substrate in vacuum were the objects of the study. Obtained low-temperature thin films were studied using the vibration spectroscopy technique in the temperature range of 16-180K. During thermal annealing of the samples, characteristic vibrational C-H bands of methane were monitored alongside desorption pressure in relation to the annealing temperature.

In the process of sample annealing we observed changes in the monitored thermodynamic parameters acting as indicators of the structure-phase state of the low-temperature thin films. The results of the study reveal that upon co-deposition of methane and water a homogeneous system is formed with various inferred states of the methane molecule in the crystalline water framework: quasi-free, pore-captured and clathrate-like.

## **REFERENCES**

1. Drobyshev, A., Aldiyarov, A., Sokolov, D., ИК спектрометрические исследования тонких пленок криовакуумных конденсатов метана и смеси метан-вода, Low Temperature Physics. 43, 3, 505-512 (2017).