

Nanooptics and photonics

Structural study of N₂ - CH₄ alloys. Cluster model

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There are many reasons for scientific interest in CH₄ – N₂ alloys. Constituents components alloy, solid nitrogen and methane are of fundamental substances for solving problems of the solid state [1]. Moreover methane is known to occur in the planetary environments [2]. Solid N₂ are formed by the linear and CH₄ - tetrahedral molecules. Both the crystal have cubic (*fcc*) lattice at the equilibrium vapor pressure, symmetry of α – N₂ corresponds to the Pa3 space group [3] and methane is described *Fm3c* [4] below 20,4 K. The nitrogen – methane solid phase diagram has been determined using X-ray diffraction method in studies [5,6]. There are large discrepancies between results of these structural works. According to [5] a phase separation in CH₄ – N₂ system was not observed and solutions are cubic at all temperatures below α - β transitions of α – N₂ at all concentrations. While authors [6] appointed that the mutual solubility of the components is practically absent in low temperature range. More experiments are required to resolve this controversy. Structure analyses of such solid solutions make it possible to obtain important information for a creation new theoretical approaches and a check of the existing models.

Structure of solid CH₄ – N₂ mixtures was studied with the transmission electron diffraction techniques equipped with a helium cryostat. The samples were grown “*in situ*” by condensation gaseous mixtures on Al or C substrate at T = 20 and T = 5 K. Based on analysis of the obtained diffraction patterns and the concentration dependences of the lattice parameter and diffraction intensity the region of existence of solid solutions was determined.

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