NONISOTHERMAL NUCLEATION IN NONIDEAL RAPIDLY COOLING VAPOR

Perevoshchikov E.E.,[1,2] ***Zhukhovitskii D.I.***[*1,2]

[1] *JIHT RAS, Moscow, Russia,* [2] *JIHT RAS, Moscow, Russia*

[*] *dmr@ihed.ras.ru*

During rapid cooling in the absence of a carrier gas, nucleation in the condensing substance becomes non-isothermal: condensation causes heating of large clusters and their temperature begins to differ from the temperature of the monomers. At the same time, data from modeling this process using the molecular dynamics method show qualitative differences in the evolution of the system compared to the isothermal case: after passing the nucleation point, the temperature of the system increases greatly, its peak increases with a decrease in the cooling rate, and the supersaturation sharply drops formally below unity; the cluster size distributions also differ.

It is shown that in the time interval between the maximum of supersaturation and the maximum of the time derivative of the degree of condensation, the temperatures of different clusters significantly approach each other, becoming almost equal to the temperature of the monomers; at the same time, the critical cluster size decreases greatly. However, formulas for calculating the critical cluster size in the nonisothermal case yield an extremely overestimated result for these conditions. Compared to simulations of a similar but isothermal process [1], the temperature at the nucleation point turns out to be significantly higher and the supersaturation, lower. The degree of condensation at which a "condensation explosion" occurs is also lower.

---

1. Perevoshchikov E. E., Zhukhovitsky D. I. // JETP. 2024. V. 65. No. 1. In press.