MICROGRAVITY SCIENCES AND PROCESSES (A2)
Fluid and Materials Sciences (2)

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DROPLET EVAPORATION AND COMBUSTION MODELING

Abstract

Combustion of most widely spread hydrocarbon fuels takes place in a gas-phase regime. Thus, evaporation of fuel from the surface of droplets turns to be one of the limiting factors of the process as well. Evaporation and combustion under terrestrial conditions is strongly influenced by gravity induced thermoconvective flows. Those effects mask the influence of non-equilibrium processes in phase transitions making the proper understanding of the phenomenon very difficult in the ground-based experiments. Besides, non-equilibrium effects have a stronger manifestation under low gravity conditions for interfaces of high curvature. The aim of the present study is to develop a mathematical model for the non-equilibrium evaporation and to determine the applicability limits for the existing quasi-equilibrium models. The problem will be solved taking evaporation of small droplets as an example. Mathematical models for individual droplets evaporation incorporated in polydispersed mixtures modeling, are usually based on the assumptions of the equilibrium character of phase transitions. Comparison of theoretical and experimental data shows that this assumption being undoubtedly valid for large droplets and flat surfaces, brings to essential errors for small droplets. The support of Russian Foundation for basic research is gratefully acknowledged (projects 09-08-13673 and 09-08-00284).