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CONCURRENT FLAME PROPAGATION OVER THE BURNING MATERIAL IN MICROGRAVITY

Abstract

Problems of flame propagation over a solid combustible material surface require special attention. This process is characterized by different directions of flame propagation (concurrent or countercurrent) and surface orientation. In all these cases, the flame, propagating over the surface of the solid fuel, heats the fuel to the temperature of its pyrolysis. As a result of it the gasified fuel interacts with the oxidizer. The nature of flame propagation over the surface of a combustible material in terrestrial and in microgravity conditions is different. If the flame spreads due to the diffusion of heat and mass or forced convection in microgravity, in terrestrial conditions buoyancy causes an upward flow of gas, which expands the flame and enhances the combustion of pyrolyzed fuel. This buoyant flow affects the mass flow rate of oxygen and fuel at the combustion site, the rate of chemical reaction in the flame, and the rate of heat transfer from the flame to the fuel surface, which in turn determines the stability of the flame and its propagation speed. Due to the resulting buoyancy effects the combustion mode with a slow forced flow (about 10–20 cm/s) cannot be exactly reproduced on Earth. Since the pyrolysis fuel and oxidizer are initially separated, the flame is diffusion, and its characteristics correspond to those of the diffusion flame in the boundary layer. The results of theoretical studies of flame propagation in microgravity above the burning surface of material are presented. A mathematical model is developed accounting for the peculiarities of diffusion combustion of fuel in the flow of oxidant. Three dimensional unsteady-state simulations of chemically reacting gas mixture above thermochemically destructing surface are performed.
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