Spin Combustion of Gasless Systems with Melting Component: 3D Simulation

V.G. Prokof'ev

Tomsk State University, Tomsk, 36, Lenin Ave., 634050, Russia,
pvg@ftf.tsu.ru

Unstable three-dimensional combustion regimes of gasless systems are one of the most interesting problems in the combustion theory. Numerical studies revealed a large number of regimes characterized by a diverse propagation of high-temperature reactions and their interaction within the framework of a three-dimensional solid-phase model. The results have shown that the so-called spin combustion (propagation of reactions along a spiral trajectory) is one of the special cases of unstable combustion. It should be noted that unstable gasless combustion regimes were found and investigated in the systems which contained a low-melting component in porous samples in experiments.

The simulation of gasless combustion, considering the melting of one of the mixture components, found the new regimes of unstable combustion. The parameters of the phase transition were shown to influence on the stability of combustion. The study found the conditions for the formation of «strong spin waves», the regimes of which differed in the rate of reactions in the axial and tangential directions. The melt is assumed can be filtrated only at a temperature that is above the melting temperature. This study presents a 3D numerical solution for the gasless combustion of a cylindrical sample with allowance for the convective flow of a melt. The conducted computations showed the qualitative influence of convective heat transfer on the characteristics of combustion.