# 3D MATHEMATICAL MODEL OF "CHEMICAL FURNACE"*

*V.G. PROKOF'EV*[1,2]

[1]*Tomsk Scientific Center, Russia*
[2]*Tomsk State University, Russia*

The method of forming powder materials in the form of a layer package allows synthesizing material for a low exothermic or even endothermic mixture in the "chemical furnace" [1, 2]. Three-dimensional modeling of gasless combustion of a three-layer sample was carried out. We considered a sample in the form of a combination of thermally conjugated flat layers consisting of two mixtures of different chemical activity — the model of a "chemical furnace" [2, 3]. Numerical simulation was previously performed of unsteady modes of gasless combustion in rectangular rods prepared from a mixture of two powdered reagents with an admixture of low-melting inert metal powder [4]. Gasless combustion of a flat three-layer package of rectangular cross section was considered. The parameters and composition of the outer layers are the same, and the inner layer has a homogeneous structure. Unsteady spin combustion regimes were studied in detail with a change in the layer thickness and sample size (fig. 1). Critical combustion conditions are established depending on the ratio of the volumes of mixtures in the sample or the content of reaction products. The time, burning rate and combustion regimes of the layer composition are determined depending on the volumetric content of the mixtures, the thickness and number of layers.

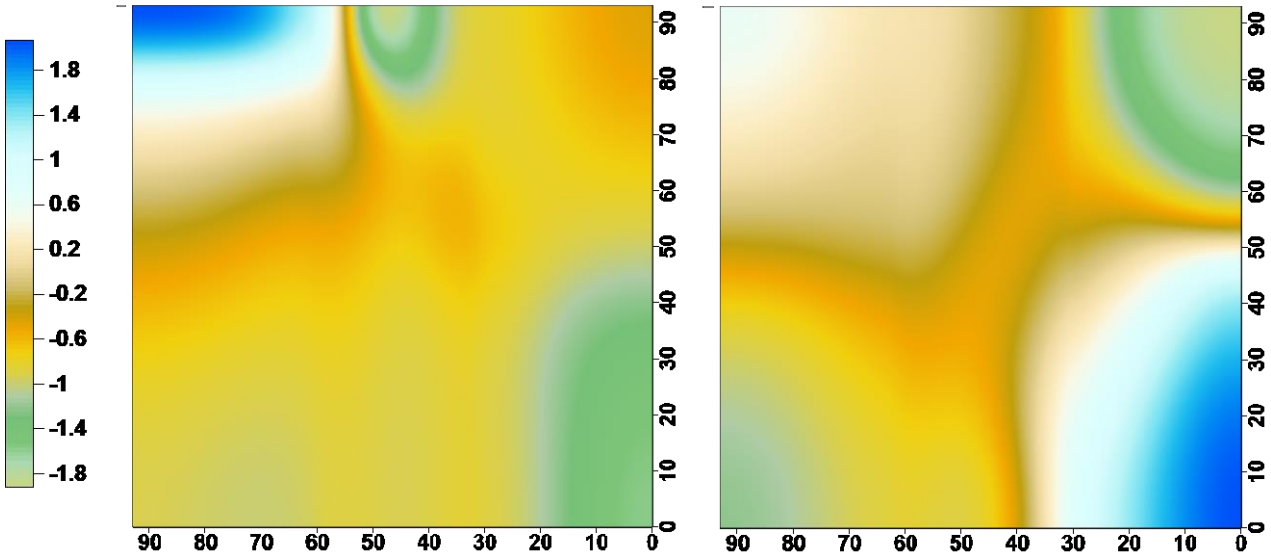


Fig.1. Spin combustion regime (temperature fields)

REFERENCES

[1] A.G. Merzhanov, "Thermally coupled processes of self-propagating high-temperature synthesis", Dokl. Phys. Chem. Vol. 434, pp. 159–162, 2010.

[2] A.V. Linde, I.A. Studenikin, A.A. Kondakov and V.V. Grachev, "Thermally coupled SHS processes in layered (Fe 2 O 3 + 2Al)/(Ti + Al)/(Fe 2 O 3 + 2Al) structures: An experimental study", Combust. Flame, vol. 208, pp. 364-368, 2019.

[3] V.G. Prokofiev and V.K. Smolyakov, "Gasless Combustion of a System of Thermally Coupled Layers", Combust., Expl., Shock Waves, vol. 52, no. 1, pp. 62-66, 2016.

[4] [1] V.G. Prokofiev and V.K. Smolyakov, "Gasless Combustion in Two_Layer Structures: A Theoretical Model", Int. J. Self-Propag. High-Temp. Synth., vol. 22, no. 1, pp. 5-10, 2013.

[5] V.G. Prokof'ev, "Unsteady Combustion Modes in Rectangular Rods", Int. J. Self-Propag. High-Temp. Synth., vol. 28, no. 3, pp. 155-158, 2019.

* The work was supported by the Russian Foundation for Basic Research (project no. 19-03-00081).