Numerical investigation of flame dynamics in two-layered system

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We consider a model of the combustion wave propagation in a system, consisting of a pair of solid fuel layers that are in thermal contact with each other along a common interface. It is assumed that the adiabatic combustion temperature of the first material is higher than the adiabatic combustion temperature of the second material. It was numerically analyzed the boundaries of stable propagation of a traveling combustion wave and the types of instabilities. It is shown that the thermal interaction between layers can increase the local temperature at the fronts of combustion waves above the adiabatic combustion temperature of the common system. This is of particular importance for the acceptor material, because such regime is favorable for conducting the Self-Propagating High-Temperature Syntesis in the chemical furnace mode [1].

The dynamics of the pulsations of the reaction wave is investigated depending on the strength of the thermal connection between the layers of the system. It is found that in a case of a weak thermal coupling between the layers, the stability limit is lower than the stability limits in the case of propagation of a combustion wave in each material separately. This type of thermal interaction is characterized by type of instability with out-of-phase pulsations of the unstable mode in different layers. For a strong thermal coupling the situation is changing to the opposite. The boundary of the stability of the joint system can be significantly higher than for each layer separately, and the instabilities is characterized by in-phase pulsations.

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[1] Merzhanov A 2010 Thermally coupled processes of self-propagating high-temperature synthesis *Doklady Physical Chemistry* vol 434 pp 159–162