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

Author: Ms. Elena Mikhalchenko
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation

Dr. Valeriy Nikitin
Lomonosov Moscow State University, Russian Federation

STUDY OF THE STRUCTURE OF THE DETONATION CELL IN MICROGRAVITY

Abstract

The structure of the gas detonation front is a complex, multidimensional and time-dependent interaction of hydrodynamics and chemical reactions. This phenomenon is the subject of numerous studies and close attention. The combined behavior of the leading and shear waves forms a triple point configuration and creates diamond-shaped patterns known as detonation cells. This key feature of gas detonation waves is usually visualized by the imprint of triple shock wave trajectories on soot foil or by stripes of enhanced light emission from shock waves using open-shutter photographic techniques. The study of the ability to maintain a detonation structure or the ability to quickly destroy it is a complex and very important task. In this work, a numerical study of the formation of a cellular structure in hydrogen and hydrocarbon fuels was carried out. The possibility of inhibiting an already existing detonation was also studied. The mathematical model is a multicomponent gas dynamics, taking into account the chemical transformations of the components. It consists of the mass balance equations for each of the components, the momentum equations, in which the stress tensor is considered to be spherical, that is, there are no viscous stresses, and the energy equation, on the right side of which there is an external source. Various sizes of detonation cells are obtained, which are consistent with experimental data. This work was supported by the subsidy given to the Federal State Institution "Scientific Research Institute for System Analysis of the Russian Academy of Sciences" to implement the state assignment on the topic No. 0580-2021-0021 "Development of algorithms and codes for multiscale processes and combustion simulations". We would like to express our gratitude to the Center for Collective Use of the Joint Supercomputer Center of the Russian Academy of Sciences for the provided computing resources.