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Author: Mr. Lyuben Stamov
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, lyubens@mail.ru

Ms. Veronika Tyurenkova
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, tyurenkova.v.v@yandex.ru
Ms. Elena Mikhalchenko
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, MikhalchenkoLena@yandex.ru

SIMULATION OF COMBUSTION IN THE COMBUSTION CHAMBER OF SOLID FUEL HYBRID ROCKET ENGINE

Abstract

In this work a three-dimensional numerical simulation of the processes in the combustion chamber of a hybrid engine was done. The Hydroxyl-terminated polybutadiene (HTPB) and Polymethyl methacrylate (PMMA) solid fuels were used for example. Gaseous oxygen and air were used as the oxidant. To research these processes, an author's software product was created. The model was considered in which a heated gaseous oxidizer injects in the combustion chamber with a supersonic speed. It interacts with a surface of the solid fuel, heat up and ignite last one. As a result of this, the decomposition products of solid fuel in gaseous form injects in the chamber and interacts with the oxidizer and burns. The geometries of the combustion chamber and solid fuel were based on experimental works for validation comparison. The numerical model of gas dynamics was based on the methods MUSCL, AUSMP and MacCormack. The solution of chemical kinetics equations was based on the Novikov method. The mathematical model of processes in the gas phase is based on Navier-Stokes equations taking into account chemical interactions. Turbulence was modeled by using the Wilcox k-w model. A series of computational calculations with different geometries of combustion chambers and solid fuels has been carried out. Parameters of physical variables and dynamics of processes inside the combustion chamber were obtained. This work was supported by the subsidy given to the Federal Science Center Scientific Research Institute for System Analysis of the Russian Academy of Sciences to implement the state assignment on the topic No. 1021061509701-5-1.2.1 "Development of algorithms and codes for multiscale processes and combustion simulations" (FNEF-2022-0021). 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.