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

Author: Dr. Anatoli Kushnirenko
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, agk@niisi.msk.ru

Mr. Lyuben Stamov
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, lyubens@mail.ru
Ms. Elena Mikhalchenko
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, MikhalchenkoLena@yandex.ru
Ms. Maria Smirnova
Lomonosov Moscow State University, Russian Federation, wonrims@inbox.ru
Ms. Veronika Tyurenkova
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation, tyurenkova.v.v@yandex.ru

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

Abstract

In this work a three-dimensional modelling of the processes that occur during the combustion of solid fuel in the combustion chamber of a hybrid engine was done. Gaseous oxygen and air were used as the oxidant. The HTPB (Hydroxyl-terminated polybutadiene) and PMMA (Polymethyl methacrylate) solid fuels were used. The investigations were conducted by using the author's program code. The developed numerical model assumes that a heated gaseous oxidizer interacts with solid fuel, heats up and ignites it. As a result, one of the decomposition products of solid fuel in gaseous form injects in the chamber, interacts with the oxidizer and it's combustion occurs. Also mathematical model is developed considering the features of diffusion combustion of fuel in an oxidizer flow. The numerical model is based on the MUSCL method of interpolation of flows on the face. The model uses the AUSMP method for the compression terms on the uniform cubic grid and the semi-implicit Novikov method for the rigid system of kinetic equations. Also the Wilcox k-w model of turbulence is used. The chamber geometry is based on the geometry of experimental combustion chambers. A comparison with experimental data was done. A series of test computational experiments was carried out, providing the distributions of physical parameters inside the combustion chamber. The influence of solid fuel geometry on the occurring processes was studied. The diffusion mode of combustion process in the combustion chamber was obtained.

Russian Foundation for basic research is acknowledged for financial support (RFBR 20-07-00587).