Modeling a detonation engine using the reduced kinetic mechanism of acetylene

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Currently, the aerospace engine industry is addressing several promising areas of development. One of them is the use of detonation combustion of fuels. The expediency of transition to detonation combustion is mainly due to the higher efficiency of the thermodynamic cycle using detonation combustion. The main advantages of the detonation engine are a compact combustion chamber, short nozzles, high combustion efficiency and low concentrations of harmful substances. The reason of switching to detonation combustion is mainly because of a higher efficiency of the thermodynamic cycle with detonation process. Currently, special attention is paid to the engine with a continuous detonation wave, this due to higher work frequencies and the possibility of a single initiation of the detonation wave. In general, there are still many problems in the design of the RDE (rotating detonation engine) combustion chamber, such as detonation initiation, stability of detonation, mixing of fuel and oxidizer. Experimental and theoretical RDE studies are conducted all over the world. In this work, we consider an abbreviated kinetic mechanism of acetylene combustion for use in simulating an engine with a continuous rotating detonation wave. The development of the mathematical models and numerical simulations were performed using the facilities of National Research Centre “Kurchatov Institute” and Federal Science Centre “Scientific Research Institute for System Analysis of the Russian Academy of Sciences”, Russia and supported by the state task No. 1023032900401-5-1.2.1 (FNEF-2024-0002).