【Grant-in-Aid for Specially Promoted Research】

Science and Engineering

Title of Project： **Study on Self-compression Type Detonation Propulsion: Evolutionary Space-Flight Demonstration Study Using Sounding Rockets**

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【Purpose and Background of the Research】

The detonation (hypersonic combustion) propulsion mechanism is now causing a revolution in the field of aerospace engineering. In the present research, we study a revolutionary self-compression-process disc-shaped rotating detonation engine with porous injectors and a detonation combustion actuator in the effort to realize an integrated propulsion device with an airplane body. We investigate the principles of advanced high performance and light weight for an aerospace system.

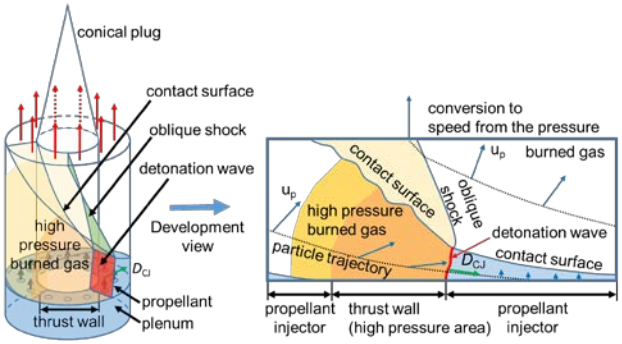

Figure 1　Detonation Engine

【Research Methods】

In the present research, we perform experimental and numerical studies in which we vary the inner diameter of the disc-shaped rotating detonation engine, in addition to the injection condition and mixture condition. We also clarify the most fundamental combustion phenomena in this engine, and the mechanism of pressure gain. We verify the limitation of the pressure gain using a multi-staged disc-shaped rotating detonation engine. We fabricated a porous cooling wall injector-type rotating detonation engine. On the fuel-oxidizer injector wall of this engine, detonation wave propagation was maintained stably. We experimentally and numerically clarify the detonation structure and heat flux into the wall, and the heat transfer coefficient from the gas flow to the wall.

We fabricate the small detonation actuator using the state-of-the-art nanometer-order machining technique, and clarify the high-speed-flow thrust characteristics of the actuator and performance of the ejector effect. We also clarify the thrust and aerodynamic characteristics (lift and drag force and rolling torque coefficients) when the engine and body are integrated by these small actuators.

【Expected Research Achievements and Scientific Significance】

We will also demonstrate the principles investigated to achieve objectives with a rocket system in a low-earth-orbit flight test using the third stage of the sounding rocket system in 2025. The present research will allow us to realize innovative propulsion performance and body structure, and will create a completely new area in the aerospace engineering field.

【Publications Relevant to the Project】

・K. Goto, J. Nishimura, A. Kawasaki, K. Matsuoka, J. Kasahara, A. Matsuo, I. Funaki, D. Nakata, M. Uchiumi, K. Higashino, Experimental Propulsive Performance and Heating Environment of Rotating Detonation Engine with Various Throat Geometries, Journal of Propulsion and Power, Vol. 35, No. 1, 2019, pp.213-223.
・Kawasaki, T. Inakawa, J. Kasahara, K. Goto, K. Matsuoka, A. Matsuo, I. Funaki, Critical Condition of Inner Cylinder Radius for Sustaining Rotating Detonation Waves in Rotating Detonation Engine Thruster, Proceedings of the Combustion Institute, Vol. 37, No. 3, 2019, pp. 3461-3469.

【Term of Project】 FY2019-2023

【Budget Allocation】 480,900 Thousand Yen

【Homepage Address and Other Contact Information】

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