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PHOENIX-2，-複数液滴の冷炎ダイナミクスの解明-，プロジェクト状況報告

PHOENIX-2, -Cool Flame Dynamics of Multiple droplets-, Project Status Report

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This Project aims to elucidate the inter-droplet interference of the higher hydrocarbon fuel which is widely used in internal combustion engine and to obtain the mechanism of cool flame generation (1-3. The project will be conducted by the Japan-Germany international cooperation using a sounding rocket. A spontaneous ignition experiment of the fuel droplet array is performed under the gravity environment, and the location and occurrence timing of the cool flame is measured. In the future, this data will be used as reference data of a simplified reaction model for numerical calculation of combustion, so that it is useful for the modeling of combustion oscillation and development of diesel engine etc.

The goal of this study is to identify the occurrence time and location of cold flames that significantly affect spontaneous ignition and to clarify the interdroplet interference effect. In order to achieve this goal, the specifications required for the experimental equipment were defined. Table 1 shows the required specifications. In this experiment, the experiment is performed in 5 kinds of droplet arrangements with a maximum of 9 droplets. In order to be able to generate droplets in a

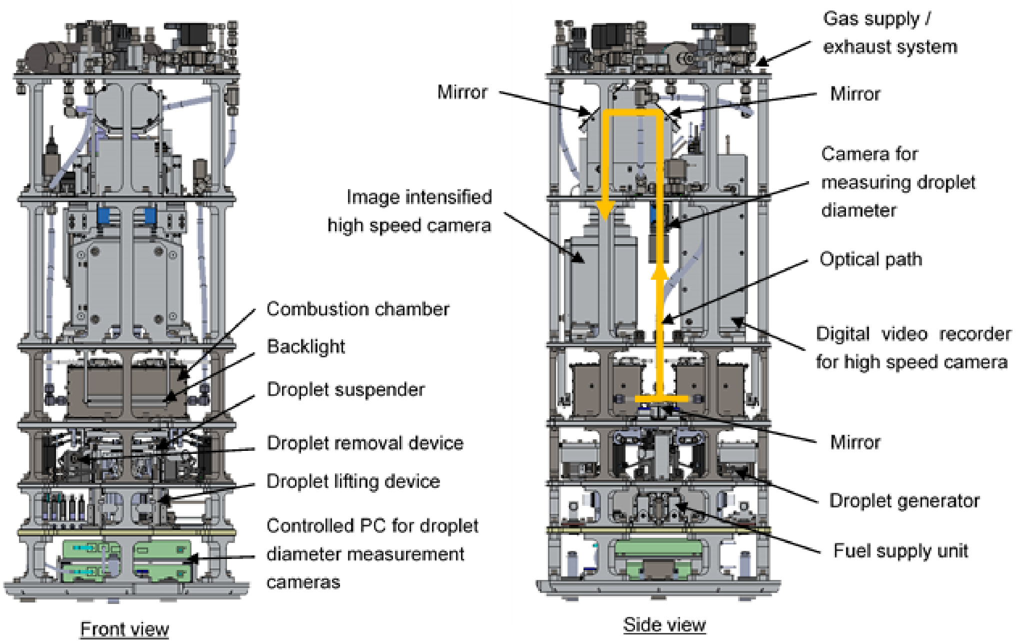

Fig.1 3D model of droplet combustion unit 2 (4.

limited time, it is necessary to generate nine droplets simultaneously. After the droplet array is suspended on the support device, it is inserted into a high temperature electric furnace in a direction perpendicular to the axis of the droplet array. In order to prevent the droplet support structure from affecting the temperature and flow when the droplet is inserted, the droplet needs to be positioned at the front with respect to the moving direction. During droplet insertion, if the movement time in a high-temperature electric furnace is long, evaporation proceeds during that time. Therefore, 100 ms or less is required for the time from the insertion of the droplet train into the combustion experimental space to the stationary state. The optical system for cold flame observation uses an intensified camera so that it can detect weak formaldehyde self-emission. In addition, it is necessary to design an optical system capable of imaging at the required resolution so as to fit within the limited space of the rocket.

The Droplet Array Combustion Experiment Unit 2 has been newly developed which satisfies this mission requirement and can be mounted on the payload of the TEXUS rocket [4]. Figure 1 shows the outline of DCU2. There are two systems of combustion vessels, etc., and data is acquired by making the best use of microgravity time of about 6 minutes. Some of the equipment elements will be diverted from the proven technology launched in the TEXUS #46 PHOENIX mission. In addition, the image-intensified high-speed camera used for cool flame observation has an observation result of cold flame under microgravity environment in the drop tower of ZARM of the University of Bremen. In this way, it is a concept that incorporates many proven equipment elements, reduces the risk of equipment development, and achieves the maximum results within the limited installation space.

Currently, the final assembly of DCU-2 is being carried out. The plan is as follows; Integrate the elements of the experimental equipment in FY 2021, complete the flight model "Droplet Combustion Unit 2 (DCU 2)" to be mounted on the rocket, conduct integrated tests in Germany in 2022 and the launch will be held in the autumn of 2022.

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