

OS3-1

ISS での液滴群燃焼実験 Group Combustion から Group Combustion-2 へ ～燃え広がりにおける冷炎発生とその影響～**From Group Combustion, Droplet-cloud-combustion Experiments aboard ISS, toward Group Combustion-2 - Appearance of Cool Flame during Flame Spread and its effect -**

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We conducted droplet-cloud combustion experiments titled "Elucidation of Flame Spread and Group Combustion Excitation Mechanism of Randomly Distributed Droplet Clouds (Group Combustion)" in 2017 as the first combustion experiments aboard the Japanese Experiment Module, Kibo, on ISS¹⁻⁵). We obtained unexpected findings from Group Combustion experiments. We observed two types of anomalous combustion phenomena near the group-combustion-excitation limit: a large-scale ignition of a droplet cluster^{2), 4)} (Fig. 1) and re-burning by a slow flame propagation in a burned area⁴⁾. The flame spread experiment over a droplet-cluster array conducted aboard Kibo well simulated these anomalous combustion and suggests that a cool flame appears around a droplet cluster existing outside the flame-spread limit and the transition from a hot-flame to a cool flame after the radiative extinction of the hot-flame although the cool-flame was not directly observed by a visible light video camera.

The findings mentioned above motivated us to plan new experiments titled ""Elucidation of Flame Spread and Group Combustion Excitation Mechanism of Randomly Distributed Droplet Clouds-2 (Group Combustion-2)" to be conducted aboard Kibo to study the role of a cool flame on the flame spread over droplet clouds. In a feasibility study (FS) for on-orbit Group Combustion-2 experiments, we tried to detect cool flames during flame spread over droplet-cloud elements using infra-red cameras in a drop facility at Yamaguchi

University ⁵⁾. We observed light emission from combustion products using a mid-wave infra-red camera and successfully detected cool flame appearance around a droplet existing outside the flame-spread limit.

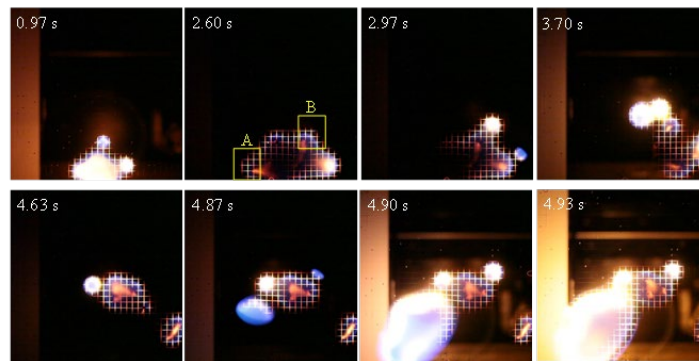


Figure 1. Flame-spread behavior with a large-scale ignition near the group-combustion-excitation limit ⁴⁾.

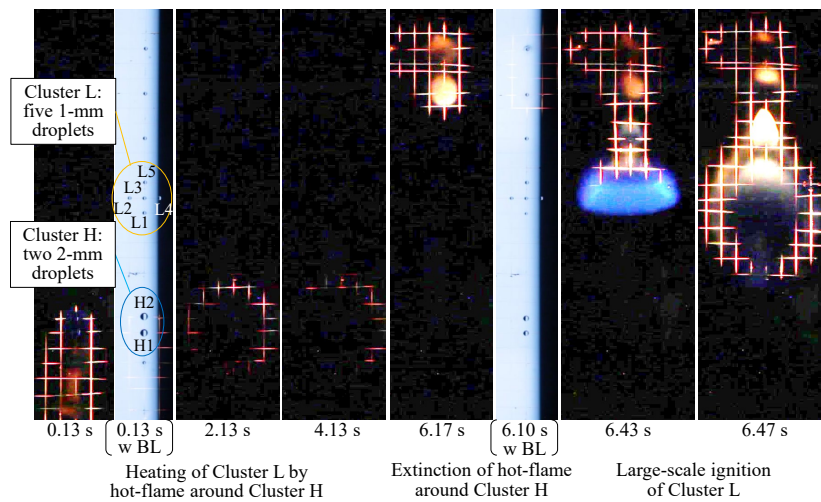


Figure 2. Flame-spread behavior over a droplet-cluster array simulating the large-scale ignition ⁴⁾.

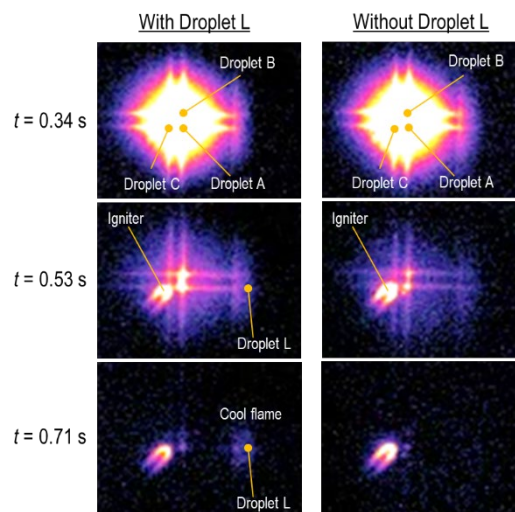


Figure 3. Mid-wave-infrared images of flame spread over droplets with and without one droplet existing outside the flame-spread limit of interactive droplets ⁵⁾.

References

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