1. Experiment Title
   Elucidation of Flame Spread and Group Combustion Excitation Mechanism of Randomly-distributed Droplet Clouds

2. Principal Investigator
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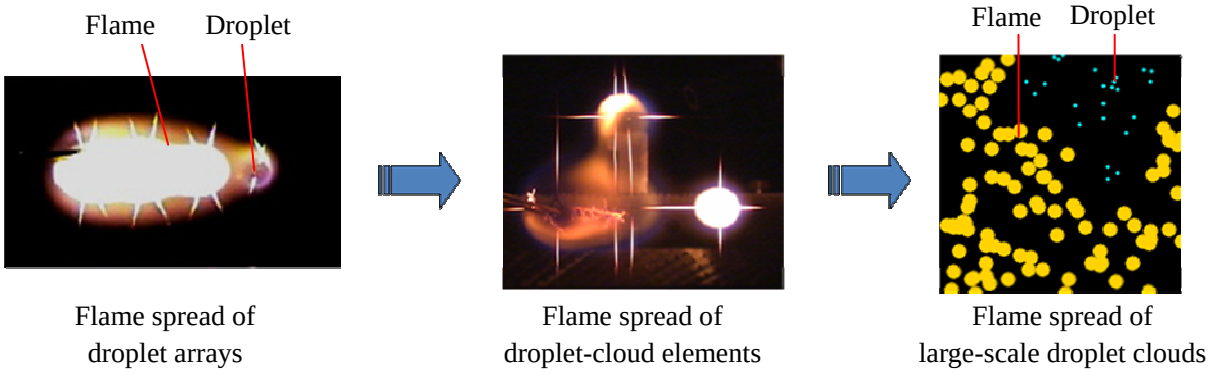
3. Outline of Experiment

   Percolation theory predicts that a transition occurs at the critical droplet-number density between partial combustion and group combustion of fuel sprays in flame spreading over randomly-distributed droplet clouds. This transition is possibly identical to the transition between incomplete combustion and stabilized combustion in practical combustors. The purposes of the present experiments are to verify the flame-spread hypotheses, which are based on the percolation theory and the findings from short-duration microgravity experiments, using large-scale droplet clouds and to develop a percolation model which well describes the group combustion excitation through the flame spread. It also verifies the hypothesis of characteristic time-scale divergence at the critical point based on the percolation theory.

   The experiments are conducted using the multi-purpose small payload rack (MPSR) and the experimental apparatus developed for MPSR. The droplets are arranged randomly on thin-fiber lattice points, and the flame and droplet positions and temperature distribution are measured during the flame spread over the droplets. The present space experiments will make high impacts on industries as well as the academic field of combustion science; the research will give a clear guideline for designing a spray combustor with stable combustion and will make it possible to bridge theoretically between the droplet combustion and the spray combustion.

4. Experiment Facility
   A small experimental apparatus using the Multi-purpose small payload rack (MPSR)



Flame spread of droplet arrays

Flame spread of droplet-cloud elements

Flame spread of large-scale droplet clouds