Overview of Kibo experiment candidates for around 2012

1. Experiment Title

Low-speed counterflow flame experiment in space for constructing unified flammability theory on oxy-fuel combustion limit

2. Principal Investigator

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3. Outline of Experiment

Carbon capture and sequestration (CCS) gains increasing attention for the prevention of the global warming. Power generation through oxy-fuel combustion with CCS is one of the promising, realistic CO2-free energy-solution which is expected to cover large portion of the future demand for electricity. To further develop oxy-fuel combustion technology, characteristics of combustion with fresh mixture containing large amount of CO2, which is thermally participating media, need to be clarified.

For establishing stable oxy-fuel combustion and its control, flammability limit of oxy-fuel combustion is one of the most important issues in the basic combustion physics to be clarified. It was concluded that flammability limit of thermally non-participating mixture is induced by the radiative heat loss from the burned gas to the ambient, that is, radiative heat losses from H2O and CO2 in the burned gas to the circumstances. Meanwhile, combustible fresh mixture which contains thermally participating gas, such as CO2, should be strengthened by its own thermal nature that may lead to significant extension or the vanishment of the flammability limit. This would be due to the reabsorption of the radiation energy by the fresh mixture where overall energy balance in the system asymptotes to the adiabatic condition.

We learnt from the flameball space-experiments by Ronney that flammability limit of flameball do exist for fresh mixtures with large amount of CO2. Hence, we need to revisit this paradox from the fundamental viewpoint of the combustion science. For this, low-speed counterflow flame technique will be applied for combustion with large amount of radiation participating gas in the present study. Gravity-free, long duration experiments only available in the space will provide a clear picture of this unresolved issue. On top of that, highly reliable computational techniques for the limit prediction, which is also of use for practical combustion technology, would be expected to be developed.