

Background of the Experiment

In low-gravity environments such as spacecraft or the lunar surface, materials may be more flammable than on Earth.

Fires in space can directly lead to serious accidents.



Image by NASA

Material suitability is determined by flammability testing.

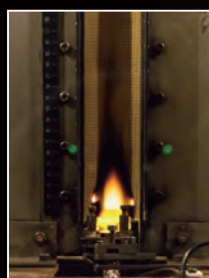
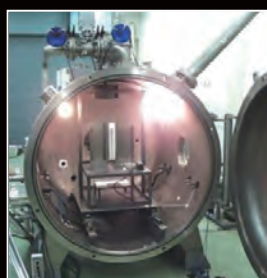
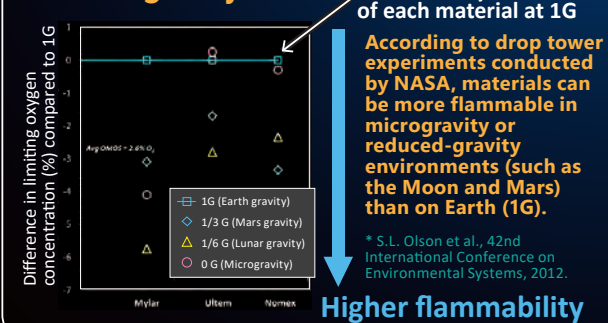


Image by NASA

Are materials actually more flammable in reduced gravity?



Experiments in the "Kibo" module

Validation data for a new method are being obtained using advanced technologies.

Features of the Solid Combustion Experiment Module (SCEM)

- SCEM enables material combustion experiments under atmospheric-pressure and **low-pressure conditions, with high-oxygen-concentration conditions*** (up to 45%). *Assumed cabin environment for the Manned Lunar Exploration (Artemis Program)
- Various experiments can be conducted by **exchanging inserts in the combustion chamber.**



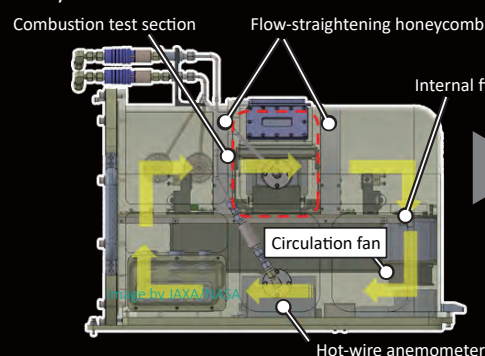
SCEM

Solid Combustion Experiment Module

Experimental Method

Formation of a circulating flow inside the combustion chamber

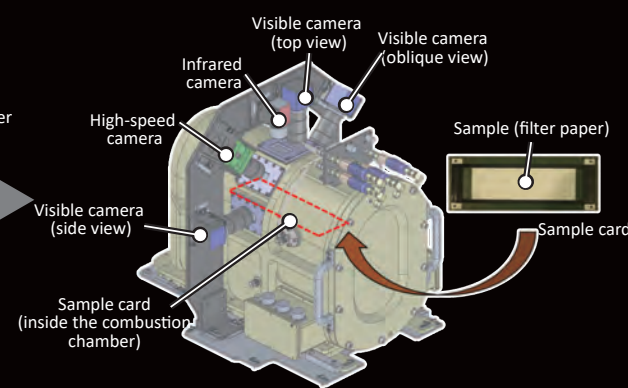
The oxygen concentration and pressure in the combustion chamber are controlled to meet the experimental conditions. A recirculating flow is generated by a fan. In the test section, the flow is conditioned by a honeycomb.



Observation of flame spread over a material surface

The sample is ignited at one end using a heating wire, and flame spread over the sample is recorded using multiple cameras. Oxygen concentration is also measured using sensors.

Samples include flammable materials such as paper and acrylic sheets, as well as flame-retardant materials used on the ISS. Experiments using insulated wires are also performed to investigate the effects of sample geometry.



FLARE Mission

Fundamental Research on International Standard of Fire Safety in Space
-base for safety of future manned mission

Principal Investigator: Osamu Fujita, Professor, Hokkaido University

- Combustion experiments using the SCEM in "Kibo" are being conducted to establish and validate flammability evaluation methods that consider gravity effects.
- Further combustion experiments on various materials using SCEM are planned in the future.



Step 2

Step 3

Step 1

Demonstration and Standardization of Materials Flammability Evaluation under Gravity Effects

- Validation of the flammability evaluation method in microgravity environments (FLARE)
- Standardization of the evaluation method within JAXA
- Establishment of JIS standards based on ISO standards for HOI testing

Step 2

Expansion of International Utilization

- International implementation of the evaluation method
- Establishment as a de facto standard for materials flammability evaluation in Low Earth Orbit (LEO)
- Demonstration of applicability to low-gravity environments such as the lunar surface (FLARE-2, FLARE-3)

Step 3

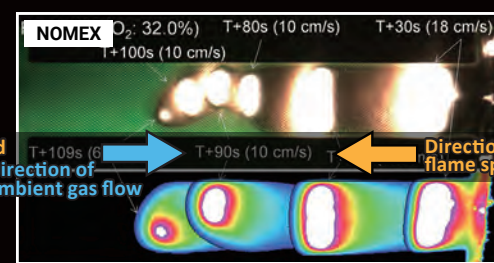
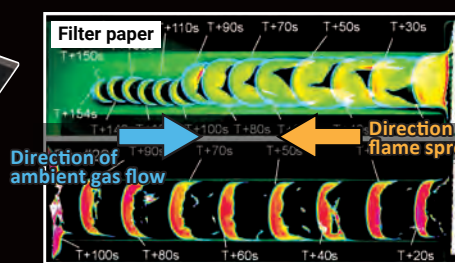
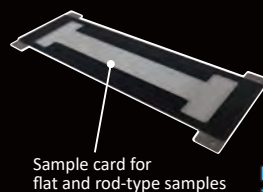
Application to Lunar Exploration and Expansion of Material Options

- Expansion of the use of new materials in space applications
- Application of the evaluation method to the Manned Lunar Exploration (Artemis Program)

Step 1 Experiments: Flame spread observation and analysis

Flat-type

Experiments were conducted to observe flame spread while varying the ambient gas flow velocity.



Composite pictures of infrared temperature distribution and visible flame images during flame spread

Wire-type

On-orbit experiments are currently ongoing!

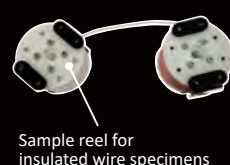


Image by Hokkaido University

Self-ignition of insulated wire samples due to overcurrent application
(Visible camera / Aircraft experiment image)