



COMBUSTION

NEXT ► Energy Cluster

This cluster shall contribute to the realization of a safety energy system and zero-emission society.

"Role of Combustion in the 21st Century"

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About 80 % of the total energy for human life and industry is generated by combustion, resulting in serious environmental issues in global scale. It is anticipated that the role of combustion as an energy source will not change dramatically in this century even if utilizations of new alternative energy sources are enhanced. Therefore, highly efficient use of combustion as an energy source is essential for the sustainable development human society. When the combustion phenomena are seen from the scientific viewpoint, i.e., "Aerothermochemistry", it is extremely complicated, which includes heat and mass transfer, chemical reaction, change in thermal properties, etc., thus chemists, mathematicians, and mechanical engineers have been interested in fundamentals of combustion extensively.

Combustion has another importance in frontier of the aerospace technology. "Scramjet engine" which is a candidate of propulsion system for a space plane is a symbol in the field. In the case of the turbojet engine, air is compressed by an axial compressor and sent to a combustion chamber, while the scramjet is an air-breathing engine and supersonic air introduced through an intake is sent to a combustion chamber and then burn with injected fuel under a supersonic state.

The theoretical speed achieved with this engine reaches approximately up to Mach 12. The largest issue of scramjet engine is how to maintain flames in a combustion chamber in a supersonic environment since flames can be easily blown out in supersonic air stream.

Research of reacting flows in an extreme state of ultrahigh-speed, high-temperature and high-pressure is necessary, and academic interest is never exhausted, thus we are conducting experiments and numerical analysis.

In addition to the combustion research, the Energy Cluster has a plan to conduct research in two major areas. One research theme is the safety issue with energy plants, such as nuclear power plants. From the viewpoint of the fluid phenomenon, water is used as a heat exchange medium that connects the nuclear power reactor and steam generator in nuclear power generation. High-pressure and a considerably high-speed water flow may erode tube wall and cause cracks in the piping system. Many of the accidents which occur at nuclear power plants are caused by the fluid phenomenon. The safety of nuclear power generation must be improved by research on the fluid phenomenon. We would like to collaborate from an engineering aspect on research activities for the improvement of safety conducted by institutions related to nuclear power safety and local electric power companies.

The other area of research is a zero-emission project, which is comprehensive research aiming at the minimization of emission matter in the environment as a result of energy use. A variety of research including combustion is conducted in Energy Cluster, and we are considering the possibility of integration of such research as a system toward the direction of zero-emission.