Advanced Core for Energetics, Hiroshima University Vol. 111

HU-ACE NEWS LETTER

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Activities of the Core

Mar. 5, 2026	The 27th HOSTY Biomass Group Seminar (31st HU-ACE Symposium): “Understanding Biofuels from the Basics” (co-organized by HU-ACE)
Mar. 16, 2026	The 6th Energy Storage Seminar (organized by HU-ACE)
Mar. 17, 2026	The 113th HU-ACE Steering Committee Meeting
Mar. 17, 2026	The 14th Geoseminar (organized by HU-ACE)
Mar. 27, 2026	The 21st Hiroshima University Biomass Premium Evening Seminar. (co-organized by HU-ACE)

HU-ACE Co-organized Biomass Symposium

On March 5, 2026, a symposium titled “Understanding Biofuels from the Basics” was held in a hybrid format. The event was co-organized by the HOSTY Biomass Group, the Biomass Project Research Center at Hiroshima University, and our center. This seminar aims to provide an accessible introduction to biomass technologies and the latest developments for participants who are not specialists in the field, those interested in biomass utilization, and professionals considering the introduction of biomass in their work. The program included three lectures on major biofuels: wood pellets, biodiesel, and biomethane. In addition, a topical lecture was delivered by Mazda Motor Corporation on biocoke, which has attracted attention as a decarbonization technology. The lecture introduced research and development aimed at utilizing biocoke in cupola furnaces. Cupola melting furnaces, which are essential equipment in cast iron production, typically use coal coke as fuel. The presentation highlighted technologies for converting biomass waste into biocoke as a substitute for coal coke, as well as demonstrations using 100% biomass coke in an actual furnace. This seminar is held annually in March, and we look forward to welcoming your participation again next year.

Related Events

The 10th International Symposium on Fuels and Energy (ISFE2026)

The International Symposium on Fuels and Energy (ISFE2026) will bring together researchers and engineers from around the world to discuss the latest advances in next-generation fuels and energy technologies. We warmly welcome your participation.

Date: July 6 (Mon) – July 7 (Tue), 2026
Website: https://symposium2026.isfe.hiroshima-u.ac.jp/ *(under preparation)*
Contact: hu-ace-info@ml.hiroshima-u.ac.jp

Research consultation and joint research are welcome.

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Do You Know Energy ? No. 11

Ammonia Combustion

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What is Ammonia Combustion?

Ammonia combustion is a form of combustion which uses ammonia (NH_3) as a fuel. Ammonia is attracting attention as a fuel that does not contain carbon, and it is also expected to serve as a hydrogen carrier because it can be easily liquefied. In the field of combustion, its fundamental combustion characteristics have been studied for over 50 years. However, due to several disadvantages, its application to practical combustors has not progressed. The main issue is that its burning velocity is about one-fifth that of hydrocarbon fuels (such as city gas and gasoline), making flame stabilization difficult. In addition, large amounts of nitrogen oxides (NO, NO_2) are emitted during ammonia combustion. Fundamental experiments have confirmed that NOx (NO + NO_2) emissions can reach around 2000 ppm, while typical regulatory limits are about 200 ppm. Furthermore, under certain conditions, nitrous oxide (N_2O) is also produced. N_2O has a global warming potential 265 times higher than CO_2, so it must be suppressed at the ppm level. In recent years, it has been shown that NOx emissions can be significantly reduced by using “two-stage combustion” in gas turbine combustors, and demonstration projects are underway for thermal power generation that partially uses ammonia as a fuel.

How is Research on Ammonia Combustion Conducted?

The Combustion Engineering Laboratory at Hiroshima University participates in a NEDO project aimed at replacing conventional natural gas with ammonia in industrial heat utilization, which accounts for about 10% of Japan’s CO_2 emissions. In collaboration with Sanken Sangyo Co., Ltd., a furnace manufacturer in Hiroshima, we have constructed a bench-scale furnace that simulates industrial furnaces to study ammonia combustion. Using high-temperature air combustion technology, we have demonstrated that NOx emissions can be reduced below current regulatory limits even when ammonia is used as the sole fuel. We also participate in another NEDO project exploring the use of ammonia as a fuel for aviation, a sector where electrification is particularly challenging. Our research focuses on measuring the ignition delay time of ammonia under high-temperature and high-pressure conditions relevant to aircraft gas turbine combustors.

Why is Research on Ammonia Combustion Important?

Ammonia combustion is important not only from the perspective of reducing CO_2 emissions but also from a scientific standpoint. Although ammonia has a very simple molecular structure, its combustion chemistry has not yet been fully understood. For example, during ammonia combustion, NOx formation occurs simultaneously with NOx reduction (DeNOx reactions) and thermal decomposition processes. Because of these complex reaction pathways, it remains difficult to quantitatively predict and control NOx formation. Furthermore, the combustion behavior of ammonia when mixed with other fuels such as hydrogen or hydrocarbon fuels (co-firing) is not yet fully understood. Thus, many aspects of ammonia combustion remain unresolved, and establishing effective control strategies based on fundamental understanding is an important research challenge.

What Future Developments and Applications are Expected for Ammonia Combustion?

In the future, ammonia is expected to be used as a fuel in various types of combustion systems to promote decarbonization.