

HU-ACE NEWS LETTER

Advanced Core for Energetics, Hiroshima University

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Activities of the Core

- Apr. 9, 2026 The 127th Hiroshima University Biomass Evening Seminar (co-organized by HU-ACE)
- Apr. 22, 2026 Special Course on Carbon Recycling (NEDO Project): 1st Session – Trends in Carbon Recycling [Introduction] (co-organized by HU-ACE)
- Apr. 22, 2026 The 114th HU-ACE Steering Committee Meeting

Professor promotion

Thanks to support and help from various people, our staff could make considerable achievements, which led to the promotion of one associate professor to professor as of April 1, 2026.



Prof. Sayaka Kindaichi

I am honored to announce my appointment as Professor in the Architecture Program of the Graduate School of Advanced Science and Engineering. I would like to extend my deepest appreciation to all members of HU-ACE for your unwavering support.

Architecture plays a crucial role in energy demand. Achieving energy conservation requires not only technological solutions but also thoughtful strategies regarding energy demand. Our laboratory conducts empirical studies to promote renewable thermal energy technologies such as ground-source heat pumps, and develops thermal storage systems that contribute to balancing energy supply and demand. I am committed to research and education aimed at creating environments that are friendly to both people and the planet. I sincerely appreciate your continued support.

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/>

Contact: hu-ace-info@ml.hiroshima-u.ac.jp



Research consultation and joint research are welcome.

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HU-ACE Secretariat, URA Division, Office of Research and Academia-Government-Community
Collaboration, Hiroshima University 1-3-2 Kagamiyama, Higashi-Hiroshima, 739-8511 Japan
E-mail: hu-ace-info@ml.hiroshima-u.ac.jp, tel:+81-82-424-4425, URL: <https://hu-ace.hiroshima-u.ac.jp/en/>

Do You Know Energy?

Elementary Kinetic Model

Akira MIYOSHI

Professor, Graduate School of Advanced and Science Engineering,
Hiroshima University, Combustion Engineering Laboratory

Research fields : Combustion Engineering, Combustion Chemistry, Reaction Kinetics

Keywords: Elementary Kinetic Model, Engine Combustion & Fuel



What is an Elementary Kinetic Model?

The combustion reactions occur via the collision of molecules. Since only up to two or three bonds are rearranged upon a collision, many elementary reactions at the molecular collision level are required to produce combustion products such as H₂O and CO₂. For example, combustion of hydrogen, the simplest fuel, occurs via the chain of 19 elementary reactions commencing with those shown in Figure 1.

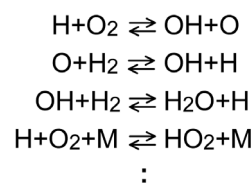


Fig. 1. Elementary Kinetic Model for Hydrogen Combustion

Why are Elementary Kinetic Models Important?

Figure 2 summarizes whether the H₂-O₂ 2:1 mixture autoignites or not depending on the temperature and pressure. As you move toward the upper right of the figure, autoignition occurs more easily because the temperature and pressure (that is, concentrations of H₂ and O₂) increase. However, the autoignition region shows a peninsula-like area extended toward low temperatures under low pressure. This strange phenomenon can only be explained with the consideration of the elementary kinetic model. Thus, the elementary kinetic model is necessary to explain and reproduce the combustion phenomena, and is playing an important role in the development of combustion technology.

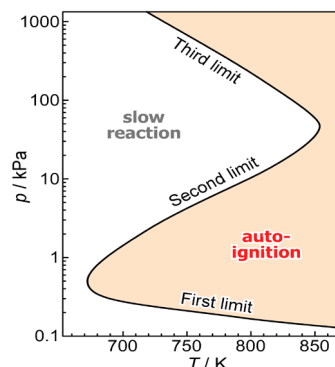


Fig. 2. Autoignition Limits of Hydrogen-Oxygen Mixture.

How are the Elementary Kinetic Models Constructed?

The elementary kinetic models have been constructed based on many studies on experimental validation and development of new methods to follow the elementary reactions, etc. Since theoretical prediction methods for elementary reactions have advanced along side developments in reaction kinetics and quantum chemistry, research is currently progressing even on reactions which are difficult to study directly. Figure 3 shows the structure of the transition state for the reaction of OH radical with dimethyl ether (DME).

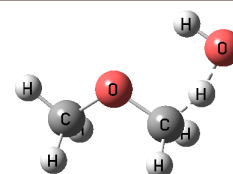


Fig. 3. Transition State for the Reaction of DME with OH

How Will Elementary Kinetic Models be Developed in the Future?

The elementary kinetic models for basic fuels (hydrogen, low hydrocarbons, and ammonia etc.) are expected to be developed in extension of the current technology. On the other hand, the current combustion kinetic models for higher hydrocarbons have been constructed by utilizing the similarity assumption. Such models are now expected to be efficiently constructed by using ML (machine learning).