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Activities of the Core

Jan.6-Feb.6,2020	JICA Training Program "Biomass Utilization"(co-organization)
Feb.10,2020	The 82nd Hiroshima University Biomass Evening Seminar (co-organization)
Feb.20,2020	54th Mechanical Systems Engineering Conference(co-organization)
Feb.20,2020	The 42th HU-ACE Steering Committee Meeting

Development of low power consumption and flexible CNT gas sensor

As gas sensors can be found everywhere, it is widely equipped. The change of physical properties of sensors can tell us the measurement value. There are several types of gas sensor and at present a semiconductor type is best among them owing to its sensitivity. However, in order to enhance its sensitivity, semiconductor types require a high temperature of 400 °C, so that it is difficult to employ apart from power outlets. Because it observes only change in resistance, they cannot identify the adsorbed molecule, and selective membrane has to be used. Collins et al. and Kong et al. reported the possibility for gas sensing even at room temperature using carbon nanotube. We found its detection mechanism and are now focusing on the development of portable and flexible gas sensor. We tried to fabricate paper-like CNT without using a support. However, the sensor form was different so that we started from examining that the sensor still followed the previous principle. JSPS KAKENHI supported this study and now we are tackling this matter.

Free-standing CNT paper

Figure: A picture of sensing part.

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Research Topics

Combustion of next generation bio-fuel for transportation

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Research fields: Combustion, Energy engineering, Thermal engineering

Keywords: Combustion, Flames, Emission, Auto-ignition, Catalytic combustion

Abstract

Background

Due to the strong demands to reduce CO_2 emission from transportation (aviation, automotive cars), high efficiency combustion devices as well as carbon neutral alternative fuels are being developed. Recently, "hydrogenated fatty acid fuel" attracts keen attention as a alternative next generation bio-fuel (NGBF) for transportation as it can be produced from inedible materials not to conflict food materials, and it can be produced as a liquid fuel of high energy density, and thus, long drivable distance and high output can be expected as conventional fossil fuels. And furthermore, NGBF are supposed to be "Drop-in", which can be supplied directly to conventional combustion devices without any modifications. Besides its great points, combustion characteristics of NGBF are not well known. According to its producing process, NGBF are supposed to consist of weakly or highly branched saturated hydrocarbons, but combustion characteristics of such fuels are not investigated in detail.

Methods

In Combustion Engineering Laboratory of Hiroshima University, ignition delay times (IDT) and laminar flame speeds (Su) of C_9H_{20} isomers are investigated systematically. IDTs are measured with newly developed, unique shock tube facility, and Su is measured with cruciform constant volume combustion chamber in National Central University in Taiwan (international corroboration). IDTs and Su are also obtained numerically with 0D and 1D codes.

Furthermore, our research is extended to application phase, that is, IDTs of hydrogenated fatty acid fuel is also investigated. We also proposed surrogate fuel for NGBF.

Results

We have investigated combustion characteristics of n-C_9H_{20} isomers from weakly to highly branched, and as a result, it is found that IDTs become longer while Su become shorter with the number of methyl branch. It is also found that IDTs and Su are numerically predictable. Combustion characteristics of hydrogenated fatty acid fuel are also investigated and surrogates are proposed based on the experimental and numerical results.

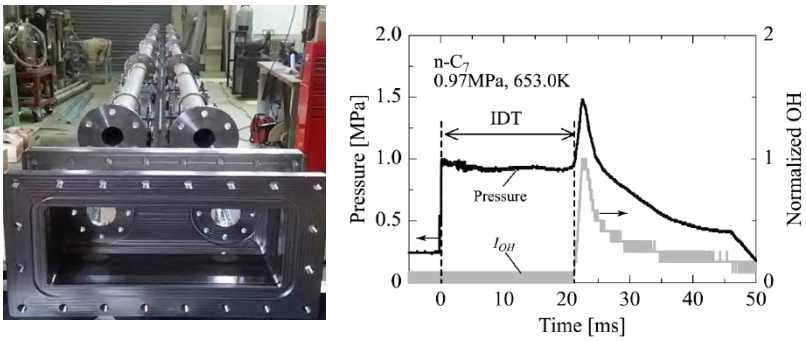

Fig. 1. Appearance of shock tube facility (left) and IDT of n-C_7H_{16}.

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