（第3号様式）(Form No. 3)

学 位 論 文 要 旨
Dissertation Summary

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論　文　名：Hydrogen Energy Production from Biomass-derived Polysaccharides using Radio Frequency In-Liquid Plasma
(Dissertation Title)

In this research, the fundamental study was conducted to produce hydrogen gas from polysaccharides, the abundant compounds in the universe, as a sustainable fuel for future. Glucose solution and cellulose suspension were decomposed by using 27.12 MHz radio-frequency in-liquid plasma with and without ultrasonic vibration.

The experimental study found that the production rate of hydrogen from decomposition of glucose solution by RF in-liquid plasma with ultrasonic irradiation applied was higher than that without ultrasonic irradiation. However, no enhancement effect of hydrogen production rate was found for the decomposition of cellulose suspension by RF in-liquid plasma with ultrasonic irradiation. In addition, high-speed camera imagery of the pattern of bubble generation by RF with the 1.6 MHz piezoelectric transducer indicated that acoustic streaming had been occurring. This raises the prospect of investigating the mechanism of acoustic streaming on plasma inside a bubble for future research.

The detailed mechanism of decomposition of glucose solution by 27.12 MHz radio-frequency in-liquid plasma with and without ultrasonic vibration for hydrogen production was investigated. The findings of mechanism of hydrogen production stimulated extensive interests in RF in-liquid plasma with ultrasonic vibration. The process of RF in-liquid plasma with and without ultrasonic vibrations induced formation of OH and H radicals that are important for decomposition of glucose molecules. The enhancement of the hydrogen production rate, hydrogen yield and hydrogen purity depends on the types of the ultrasonic vibration used. A higher range frequency, 1.6 MHz piezoelectric transducer enhanced the hydrogen production rate. On the other hand, a lower range frequency, 29 kHz ultrasonic transducer enhanced the hydrogen yield and hydrogen purity of the glucose decomposition. A combination of acoustic streaming and agitation effect from both higher and lower range frequencies of ultrasonic vibration could possibly be applied for better hydrogen production process. The hydrogen production efficiency of RF in-liquid plasma with ultrasonic vibrations was generally lower than

that without ultrasonic vibrations but it still can be considered as a promising technique for hydrogen production in the future.