3P18

誘電体バリア放電を用いたメタンガスの改質による水素生成反応の特性調査
Characterization of Hydrogen Production Reaction by Methane Gas Reforming Using Dielectric Barrier Discharges

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Introduction

In recent years, the scale of energy consumption is expanding. Hydrogen has been attracting attention as a new clean energy instead of fossil fuels. Although the energy conversion efficiency is very high (~80%) and carbon dioxide is not emitted during combustion, high pressure and extremely low temperature are required for the hydrogen storage, which is a major obstacle to practical uses. The hydrogen production by reforming hydrocarbon gas using a non-thermal plasma has been proposed [1]. In this system, it is not necessary to store H_2 under high pressure condition. Dielectric barrier discharge can generate a non-thermal plasma with a simple electrode system. In this study, waveforms of applied voltage on hydrogen production from methane reforming using DBD is investigated.

Experimental setup

Figure 1 shows the schematic diagram of the DBD system. A parallel-plate DBD reactor is consisted of a stainless steel and a glass, placed in a vacuum chamber. The gap length of the electrode is 1 mm. The chamber is evacuated to 10 Pa, and then filled with a methane gas up to 1.5 atm. Three types of high voltage power generators which output a sinusoidal voltage, a bipolar pulse voltage, and a nano-second pulse voltage are used to control the waveform. The gas inside the chamber is sampled every 15 minutes of discharge treatment. H_2 concentration is determined by a gas chromatograph (Shimazu, GC 8-A).

Results

Figure 2 shows the hydrogen production efficiency as a function of input energy for various pulse repetition rate. The energy efficiency is almost independent of the pulse repetition rate and input power. In the case of ns-pulse, the hydrogen production efficiency is about 0.9 g/kWh and is approximately two times higher than that of bipolar pulse. The microdischarge is uniformly generated over the entire electrode and the energy loss is suppressed. Therefore, the energy efficiency for the ns-pulse is much higher than those of sine wave and bipolar pulse.

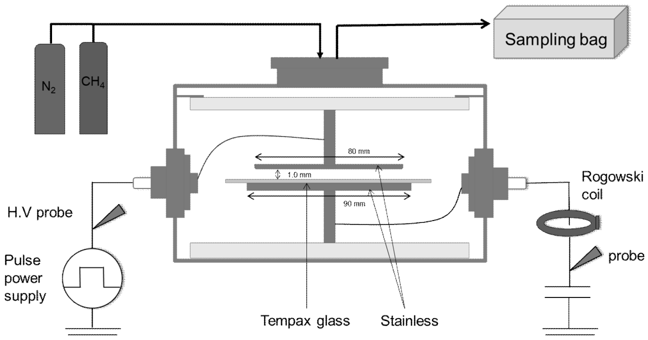

Fig. 1. Schematic diagram of the experimental set up

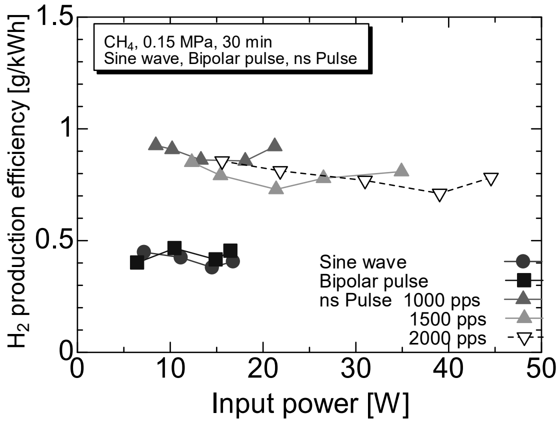

Fig. 2. H_2 production efficiency as a function of input power and pulse repetition rates

References

1) Yasushi Nishida *et al,* IEEE Trans. Plasma Sci. 46 (2018) 962 and references therein.