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ロングDCアークによる炭化水素の分解機構
Decomposition mechanism of hydrocarbon by Long DC Arc Plasma

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1. Introduction

Hydrogen has received much attention in a view of the renewable energy. The most common process for the H_2 production is a mainly steam reforming from hydrocarbons. However, it emits CO_2 as a final product. H_2 production processes without CO_2 emission to the atmosphere are water splitting and hydrocarbon pyrolysis. Mass production of H_2 is feasible in thermal plasma pyrolysis of hydrocarbon due to high temperature and high chemical reactivity. Furthermore, thermal plasmas enable to co-produce H_2 and carbon black at simultaneously [1].

Long DC arc has a long electrode gap distance of 300 mm, resulting in sufficiently long residence time for decomposition of harmful target [2]. However, the investigation for hydrocarbon pyrolysis using the long DC arc has not been clarified yet. The purpose of this study is to decompose hydrocarbons by long DC arc and to investigate decomposition mechanism.

2. Experiment

The setup consists of a power supply, a plasma torch, a gas chromatograph (GC), a pump, and a filter as shown in **Fig. 1**. The arc current was 8-13 A. The feedstock was CH_4 as the main component of natural gas. Argon was used as the plasma gas at 30 L/min, while CH_4 was injected at 0.5 L/min. The produced gases were analyzed by GC to investigate the gas composition and to estimate the decomposition rate. The solid products were analyzed by Raman spectroscopy and Scanning Electron Microscope.

3. Results and Discussion

Figure 2 shows the effect of arc current on CH_4 decomposition rate and H_2 conversion rate. The highest decomposition rate was 92% at 13 A. Decomposition rate increased with an increase of arc current. This is due to the higher arc temperature by higher arc current, which finally results in further decomposition of the CH_4.

Hydrogen was obtained as the main gaseous product of CH_4 pyrolysis by GC analysis. The conversion rate of H_2 also increased with an increase of arc current. This results from the higher decomposition of CH_4 at higher arc current as mentioned above.

4. Conclusion

High decomposition rate of hydrocarbon was achieved by long DC arc. The major gaseous product was H_2. Long DC arc system is expected to play an important role in the H_2 production.

References

[1] M. Gautier, et al., Int. J. Hydrog. Energy, 42(43), 28140-28156 (2017)

[2] S. Choi, et al., J. Chem. Eng. Jpn, **46**, 201-208 (2013).

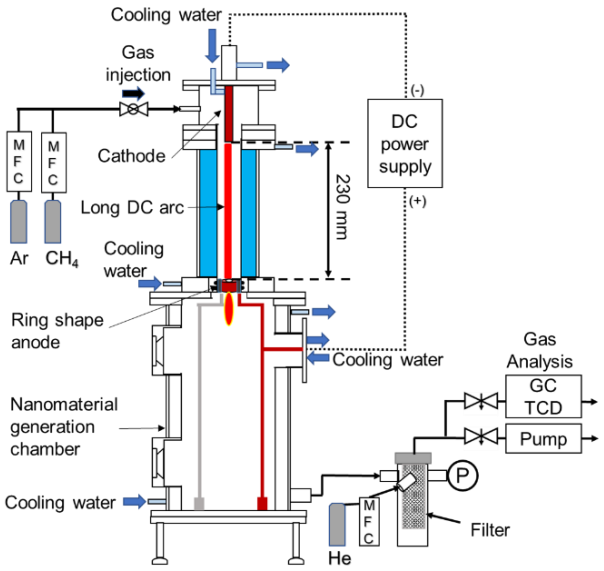

Fig. 1 Schematic diagram of Long DC arc system.

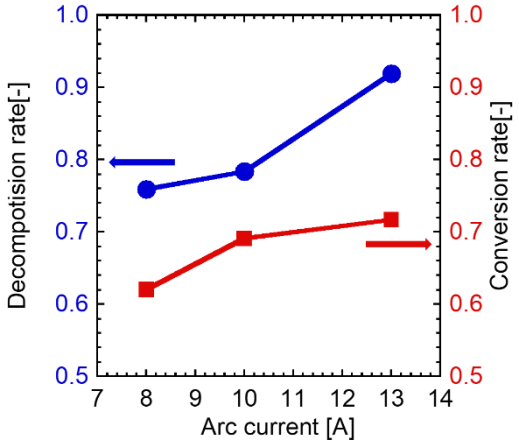

Fig. 2 Effect of arc current on decomposition rate and conversion rate of CH_4 pyrolysis.