

論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

系・コース : Department of, Graduate major in	Mechanical Engineering	系 コース	申請学位 (専攻分野) : Academic Degree Requested	博士 Doctor of	(Engineering)
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

One of the key factors in increasing automotive applications of PEMFCs is to enhance of reliability and durability of PEMFC. To do this requires a good understanding of important issues related to operating fuel cells, such as the flooding/dehydration phenomena due to water/heat generations within a PEMFC as well as gas crossover through the membrane of a PEMFC. This is because the flooding phenomena causes corrosion of the electrodes and electrolyte such as GDL, catalyst layer, and membrane. In contrast to this, if membrane becomes dehydrated which causes stress concentration of the membrane, leading to membrane pinholes, delamination and cracking, and acceleration of chemical degradation. Besides, gas crossover phenomena which causes the formation of hydrogen peroxide (H_2O_2), H_2O_2 is subsequently decomposed to peroxide ($HO\cdot$) and hydroperoxide ($HOO\cdot$) radicals and degraded the MEA properties.

Therefore, the overall goal of the present thesis is to conduct both of experimental and numerical analysis, with emphasis on gas crossover through the membrane with different geometric parameters of MEA and operating conditions. Specifically, the main objectives of this dissertation are described as follows:

- **Chapter 1** outlines the research background, from the reduction environmental pollution emission caused by internal combustion engine vehicles using petroleum-derived fuels has motivated the use of alternative energy sources for transportation such as electric vehicles. And PEMFC has known as a promising energy solution for the future for EVs. However, the issues and challenges associated with its operation and global usage proliferation. The issues are narrowed down into two major topics, which are thermal and water management, and durability, which form the subject of this dissertation work itself.
- **Chapter 2** describes the intensive experimental and modeling work associated

with understanding durability issue of the membrane of PEM fuel cell. First, a detailed description of physical and chemical degradation mechanisms of the membrane in a PEM fuel cell is done. This is followed by the construction of an experimental cell with the capability of assessing a typical PEMFC performance with a set operating parameters by a polarization curve, and measuring the diffusion-limited current distribution in-situ via microprobe method is made. Later, the single-phase model development using open source software. Via single-phase model, gas crossover through the membrane is investigated at very low current density. The single-phase model is validated with polarization curves, and the diffusion coefficient of gas crossover through the membrane which is numerically simulated is compared with experimentally calculated data. Discussions on the results are done mainly on water content in the membrane distribution at various operating conditions, and their role in assessing gas crossover through the membrane of PEM fuel cell.

- **Chapter 3** describes the extension of the modeling work in the previous chapter by using two-phase model. Description on modeling work with respect to effect of liquid water on the cell performance and gas crossover at higher current density is made. The results are discussed primarily on the effects of varying operating conditions such as operating pressure, gas stoichiometry, and MEA's geometric parameter in the gas crossover through the membrane, to which validation work is done with published literature data.
- **Chapter 4** summarizes the important conclusions in the research work contained in this dissertation. The chapter also proposes future work that can be done to address unresolved issues, minimize assumptions, and expand its usage limits.
- In addition to the above, the dissertation also contains one **Appendix** to explain specifically numerical method used this work.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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