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Efficiency of Polymer Electrolyte Membrane Fuel Cell Stack

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Abstrak

Paper ini mengaplikasikan sebuah feedforward control dengan optimal oxygen excess ratio yang memaksimalkan net power (meningkatkan efisiensi) dari NedStack P8.0-64 PEM fuel cell stack (FCS) system. Profil net power yang merupakan fungsi dari oxygen excess ratio untuk beberapa titik kerja dianalisa dengan menggunakan model dari FCS. Hubungan antara arus stack dan tegangan input kompresor pada saat nilai oxygen excess ratio optimal digunakan untuk mendesain sebuah skema kontrol feedforward. Hasil dari skema kontrol ini akan dibandingkan dengan hasil dari skema kontrol yang menggunakan nilai konstan oxygen excess ratio. Hasil simulasi menunjukkan bahwa optimal excess ratio meningkatkan performansi dari fuel cell dibanding penggunaan konstan oxygen excess ratio. Prosedur yang sama juga dilakukan secara eksperimen untuk FCS system. Respon net power dari fuel cell terhadap variasi oxygen excess ratio digunakan untuk mendapatkan nilai optimum dari oxygen excess ratio. Data data dari arus stak dan tegangan input kompressor pada saat nilai optimum tersebut digunakan untuk mendesain feedforward kontrol. Feedforward kontrol dengan konstan dan optimal oxygen ratio kontrol diimplementasikan pada NedStack P8.0-64 PEM FCS system dengan menggunakan Labview. Hasil implementasi menunjukkan bahwa feedforward kontrol dengan optimal oxygen excess ratio meningkatkan performansi fuel cell dibanding penggunaan konstan oxygen excess ratio.

Kata kunci: *PEM fuel cell stack, dynamic oxygen excess ratio, static oxygen excess ratio*

Abstract

This paper applies a feedforward control of optimal oxygen excess ratio that maximize net power (improve efficiency) of a NedStack P8.0-64 PEM fuel cell stack (FCS) system. Net powers profile as a function of oxygen excess ratio for some points of operation are analyzed by using FCS model. The relationships between stack current and the corresponding control input voltage that gives an optimal oxygen excess ratio are used to design a feedforward control scheme. The results of this scheme are compared to the results of a feedforward control using a constant oxygen excess ratio. Simulation results show that optimal oxygen excess ratio improves fuel cell performance compared to the results of constant oxygen excess ratio. The same procedures are performed experimentally for the FCS system. The behaviour of the net power of the fuel cell stack with respect to the variation of oxygen excess ratio is analyzed to obtain optimal values. Data of stack current and the corresponding voltage input to the compressor that gives optimal values of oxygen excess ratio are used to develop a feedforward control. Feedforward control based on constant and optimal oxygen excess ratio control, are implemented in the NedStack P8.0-64 PEM fuel cell stack system by using LabVIEW. Implementation results shows that optimal oxygen excess ratio control improves the fuel cell performance compared to the constant oxygen excess ratio control.

Keywords: *PEM fuel cell stack, optimal oxygen excess ratio, constant oxygen excess ratio*

1. Introduction

Power generation using polymer electrolyte membrane (PEM) fuel cells for hybrid vehicle application has received considerable attention in recent years. Fuel cells are proven as a clean energy which produces water and heat as an emission. The major advantages of using

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