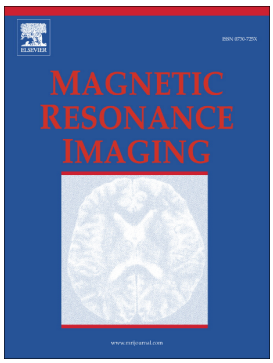

Two dimensional distribution measurement of electric current generated in a polymer electrolyte fuel cell using 49 NMR surface coils

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Two dimensional distribution measurement of electric current generated in a polymer electrolyte fuel cell using 49 NMR surface coils

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Highlights

- A method of measuring a 2D current map in a PEFC using 49 NMR coils has been developed.
- The use of coarse graining and a stepwise search shortened the time for inverse analysis.
- Maps of electric current and water content in the MEA of a PEFC generated at 100 A were measured.

Abstract

In order to increase the current density generated in a PEFC (polymer electrolyte fuel cell), a method for measuring the spatial distribution of both the current and the water content of the MEA (membrane electrode assembly) is necessary. Based on the frequency shifts of NMR (nuclear magnetic resonance) signals acquired from the water contained in the MEA using 49 NMR coils in a 7 x 7 arrangement inserted in the PEFC, a method for measuring the two-dimensional spatial distribution of electric current generated in a unit cell with a power generation area of 140 mm x 160 mm was devised. We also developed an inverse analysis method to determine the two-dimensional electric current distribution that can be applied to actual PEFC connections. Two analytical techniques, namely coarse graining of segments and stepwise search, were used to shorten the calculation time required for inverse analysis of the electric current map. Using this method and techniques, spatial distributions of electric current and water content in the MEA were obtained when the PEFC generated electric power at 100 A.

Key words; frequency shift, surface coil, current measurement, polymer electrolyte fuel cell, two dimensional distribution

1. Introduction

In Japan, cars which use a PEFC (polymer electrolyte fuel cell) were released as commercial vehicles at the end of 2015. Improvements to the PEFC to make it smaller and able to generate a higher output power have been actively conducted. An important aspect to improve is water management in a PEFC and uniformization of the