Modelling of a Direct Methanol Fuel Cell

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Abstract

This work aims at the modelling of a 5 cm^2 Direct Methanol Fuel Cell (DMFC) with mixed serial/parallel serpentine flow fields in terms of current/voltage behaviour. The geometrical design of the single cell is presented in figure 1. The function principle as well as the electrochemical reaction occurring in anode and cathode chambers are schematically presented in Figure 2. One of the main challenge to overcome consists on lowering the so-called methanol cross over from the anode through the polymer membrane to the cathode that is responsible for mixed-potential formation at the cathode where both reactions namely oxygen reduction (ORR) and cathodic methanol oxidation (MOR) simultaneously occurs and affects electrochemical performances. An overview of used equations is given in Table 1. All modelling steps have been carried out by using COMSOL Multiphysics® software and especially the Batteries & Fuel Cells Module. Influence of dependent variables such as cell temperature and methanol concentration on current/voltage characteristics will be presented.

Figures used in the abstract

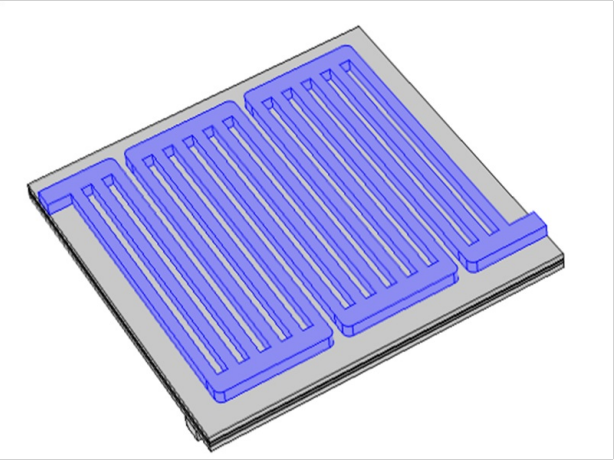

Figure 1: Description of DMFC flow field geometry

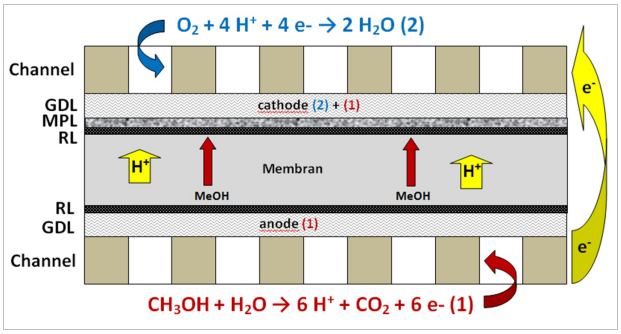

Figure 2: Function principle of a DMFC

Electronic/Ionic charge balance	Ohm's law	
Charge transfer kinetics	Butler-Volmer Tafel	
Charge transport in electrolyte	Nernst-Planck	
Coupled mass transport in free channel and porous electrode	Navier-Stokes	
	Brinkman	
Mass balances in gas phase in gas channels and porous electrodes	Ficksche	
	Maxwell-Stefan	

Figure 3: List of kinetics and mass transport equations

Figure 4