**Supplementary Materials for**

**Single and Double-sided Coated Gas Diffusion Layers used in Polymer Electrolyte Fuel Cells: A Numerical Study**

I. C. Okereke a, b, M.S. Ismail c, D.B. Ingham a, K.J. Hughes a\*, L. Ma a, M. Pourkashaniana, d

*a Energy Institute, The University of Sheffield, Sheffield, UK.*

*b Department of Mechanical Engineering, Faculty of Engineering, Akwa Ibom State University, Nigeria.*

*c School of Engineering, University of Hull, Hull HU6 7RX, UK*

*d Translational Energy Research Centre, The University of Sheffield, Sheffield, UK.*

**Corresponding author**: K.J.Hughes@sheffield.ac.uk (K.J. Hughes)

**Source terms used in the transport equations:**

1. **Mass transport:**

= 0. Where is the mass source term

1. **Momentum transport:**

=

where is the momentum source, is the dynamic viscosity, is the velocity vector, and is the permeability.

1. **Species transport:**

is the source term that represents either consumption/production of species (H2, O2 or H2O) and is given as follows (Ismail et al., 2012, Okereke et al.,2023):

where and are the anodic and cathodic local current density respectively, and are the anodic and cathodic specific surface areas respectively, is the Faraday’s constant (96485 C/mol), and , and are the molecular weights for hydrogen, oxygen and water respectively.

1. **Energy transport:**

 is the heat source term and takes one of the following forms in each fuel cell component (Li et al., 2017):

where and are the anode and cathode exchange current densities, and are the solid phase and membrane phase current densities, and are the electrical and ionic conductivities of the solid and membrane phases respectively, and and are the anodic and cathodic overpotential, and are the reaction entropies at anode and cathode catalyst layers respectively.

**5.** **Charge transport:**

 and are the solid-phase potential and membrane-phase potential respectively and are given as follows (Alhazmi et al., 2013):

where and are the volumetric exchange current density (A/m³) at the anode and cathode catalyst layers respectively and are obtained using Butler-Volmer equations (Zawodzinski et al., 1993):

where and are the reference anodic and cathodic exchange current density respectively, and are respectively the anode and cathode transfer coefficients for the electrochemical reactions in the anode catalyst layer, and are respectively the anode and cathode transfer coefficients in the cathode catalyst layer, and are the reference hydrogen and oxygen concentrations respectively, is the Faraday’s constant and is the universal gas constant.  and are the anodic and cathodic overpotential and are given as follows:

where is the reference potential of the electrodes and is equal to zero for the anode, while for the cathode it is equal to the equilibrium cell potential () (Gostick et al., 2006; Pharaoh et al., 2006):

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The membrane ionic conductivity, , is estimated using an empirical correlation developed by Springer et al. (1991):

where is the membrane water content which is empirically correlated by Zawodzinski et al. (1993):

where  is the water activity and is given as (Ismail et al., 2012):

where is the partial pressure of water vapour and  is the pressure of saturated water vapor which is given by (Ismail et al., 2012):

**6. Liquid water transport:**

 is the source for the liquid phase, and is specified as follows (Li et al., 2017):

= at the cathode catalyst layer.

= at the anode catalyst layer, anode gas diffusion layer, and the cathode gas diffusion layer given as follows:

=

where is the rate of condensation, is the rate of evaporation, is the density of liquid water, and is the mole fraction of water vapour.

= at the anode catalyst layer

= at the cathode catalyst layer

where is the density of the dry membrane and is the membrane equivalent weight.