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Erratum

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Numerical optimization of bipolar plates and gas diffusion layers for PEM fuel cells

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Unfortunately, several symbols were misrepresented or omitted in the above-mentioned paper:

1. In the List of symbols on p. 1, the symbol for ''Potential V'' should be ''φ'' instead of ''ϕ''.
2. In the boundary conditions defined in paragraph 2.2 of this paper, the symbol '' $\leq$ '' has been omitted several times. Paragraph 2.2 should have appeared as follows:

2.2. Governing equations and boundary conditions

The Stephan–Maxwell equation was used to describe mass transfer in the bipolar plate channels and gas diffusion layers. The distribution of gas flow in the channels was described by means of the Navier–Stokes equation for quasi-steady flow. The proton flux in the membrane and electrocatalytic layer was calculated using the Nernst–Planck equation. Thermal processes were described through appropriate heat transfer equations.

When using a bipolar plate with a linear arrangement of channels and ribs (as for other types of bipolar plate) the surface of the electrocatalytic layer may not be equally accessible for a reagent transporting from the bipolar plate channels through the gas diffusion layers. Due to the increase in the diffusion length, additional diffusion limitations may occur for areas of electrocatalytic layer surface located opposite to current transfer ribs, contacting the gas diffusion layer (Figure 1). On the other hand, an increase in ohmic losses in the gas diffusion layer may occur in the areas above the channels.

An elemental section ''middle of rib to middle of channel'' (see Figure 1) was considered. Mass transfer in the porous gas diffusion layer was calculated using a second order equation:

$$D\frac{\partial^2 n}{\partial x^2} + D\frac{\partial^2 n}{\partial y^2} = 0. \tag{1}$$

The boundary conditions are

$$x = 0,\ 0 \le y \le h:\ \frac{\partial n}{\partial y} = 0$$
$$x = \frac{d_r + d_c}{2}, 0 \le y \le h:\ \frac{\partial n}{\partial y} = 0$$
$$y = 0,\ 0 \le x \le \frac{d_r + d_c}{2}:\ D\frac{\partial n}{\partial y} = \frac{i}{4F}$$
$$y = h,\ 0 \le x < \frac{d_r}{2}:\ \frac{\partial n}{\partial y} = 0$$
$$y = h,\ \frac{d_r}{2} \le x < \frac{d_r + d_c}{2}:\ n = n_o.$$

The potential distribution in the gas diffusion layer was described by a similar equation:

$$\frac{1}{\rho_x}\frac{\partial^2 \varphi}{\partial x^2} + \frac{1}{\rho_y}\frac{\partial^2 \varphi}{\partial y^2} = 0. \tag{2}$$

The boundary conditions are

$$x = 0,\ 0 \le y \le h:\ \frac{\partial \varphi}{\partial x} = 0$$
$$x = \frac{d_r + d_c}{2}, 0 \le y \le h:\ \frac{\partial \varphi}{\partial x} = 0$$
$$y = h,\ 0 \le x < \frac{d_r}{2}:\ \varphi = U_{\text{out}}$$
$$y = h,\ \frac{d_r}{2} \le x < \frac{d_r + d_c}{2}:\ \frac{\partial \varphi}{\partial y} = 0.$$

The condition connecting potential and concentration of reagent in the electrocatalytic layer is

$$y = 0, 0 \le x \le \frac{d_r + d_c}{2}:\ i = \frac{1}{\rho_y}\frac{\partial \varphi}{\partial y} = 4FD\frac{\partial n}{\partial y}.$$

Taking into consideration that $i = i_0 \frac{p}{p_0} \exp\frac{\alpha z F \eta}{RT}$ (Tafel equation) and $\varphi = E_{\text{eq}} - \eta - iR_{\text{ef}}$, the current density at the boundary between cathode electrocatalytic and gas diffusion layers is given by the following equation:

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$$E_{eq} - \varphi - iR_{ef} = \frac{RT}{\alpha zF} \ln \frac{i}{i_0} \frac{p_0}{p} = 0. \quad (3)$$

To account for the influence of the gas diffusion layer porosity on the diffusion coefficient of a reagent and on electrical conductivity the following equations were used:

$$D = D_0 \varepsilon^{1.5}$$
$$\rho = \rho_0 (1 - \varepsilon)^{-1.5}.$$

Furthermore, the model accounts for the transport of water in the membrane and the electrocatalytic and gas diffusion layers. However, this item is beyond the scope of this article and will be published separately.