Fluid Behavior Through a Simulated PEMFC Gas Diffusion Layer

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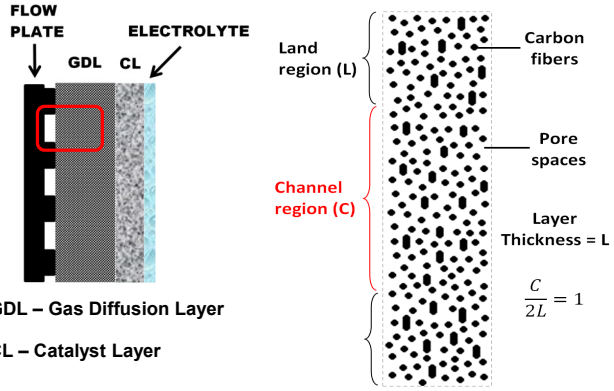
Model Characteristics



GDL – Gas Diffusion Layer

CL – Catalyst Layer

Governing equations

$$\frac{\partial f_i(r,t)}{\partial t} + c_i \nabla f_i(r,t) = \frac{1}{\tau}\left[f_i^{eq}(r,t) - f_i(r,t)\right]$$

$$f_i^{eq}(r) = w_i \ \rho(r) \left[1 + 3\frac{c_i \cdot u}{c^2} + \frac{9}{2}\frac{(c_i \cdot u)^2}{c^4} - \frac{3}{2}\frac{u^2}{c^2}\right]$$

$$\varphi_{2D} = \frac{Void\ area}{Total\ area} = \frac{Void\ area}{Void\ area + Solid\ area}$$

$$\tau_{gas-phase} = \frac{Actual\ path}{Shortest\ distance} = \frac{\sum_{i,j} u_{mag}(i,j)}{\sum_{i,j} |u_x(i,j)|}$$

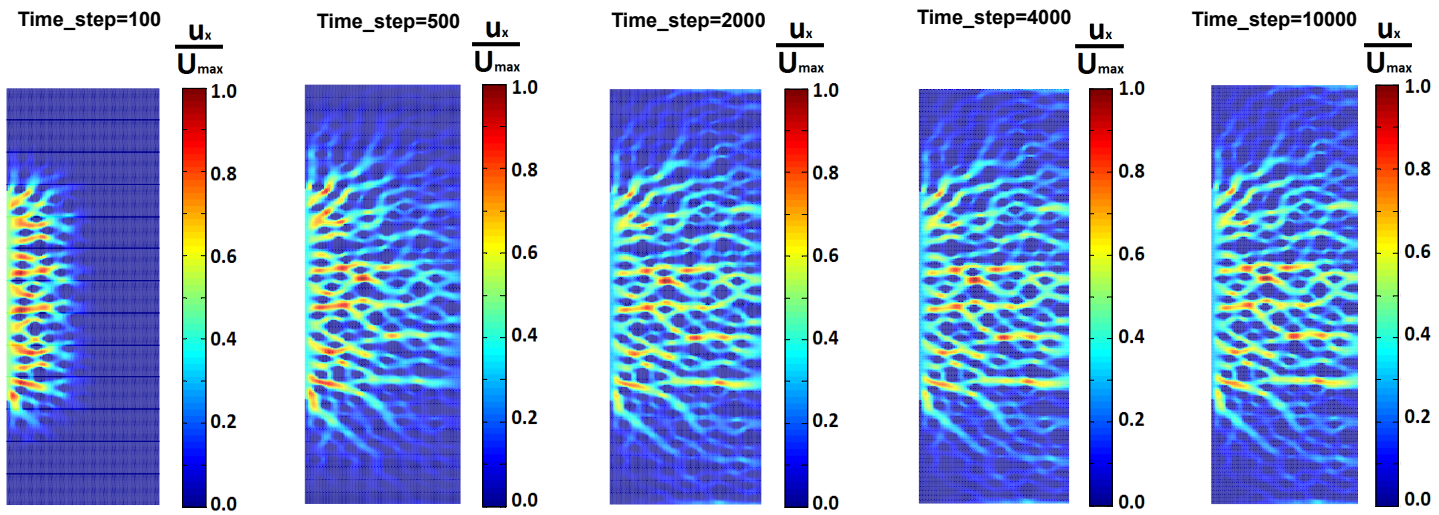
Scientific approach

- Lattice Boltzmann Method.
- Scheme used: D2Q9.
- Momentum conservation equation.
- Fluid captured at different time steps.
- Tortuosity calculated using the 2D velocity field.

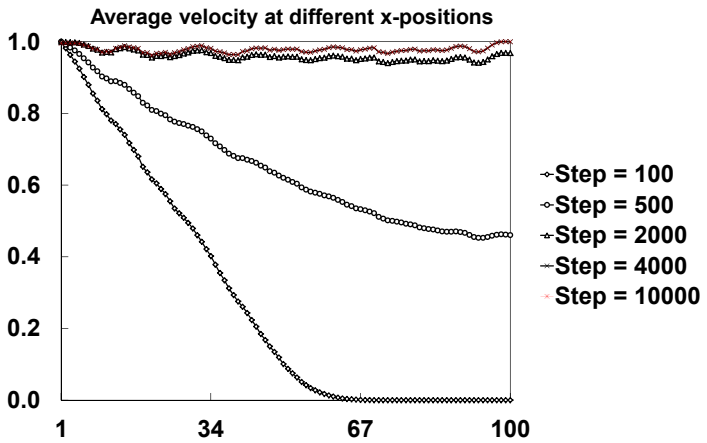
Conclusions

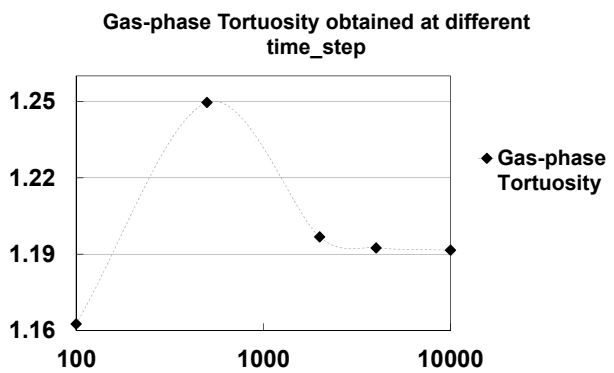
- The velocity field using D2Q9 LBM scheme was obtained at different time steps.
- The behavior of the fluid through the microstructures can be observed.
- Porosity (0.7770) and tortuosity (1.1916) are evaluated for the implemented model.

Velocity Field



Average Velocity - Tortuosity





Porosity = 0.7770