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**Fluid Behavior Through a Simulated PEMFC Gas Diffusion Layer**

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**Scientific approach**

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

**Model Characteristics**

- **FLOW PLANE**
- **GDL – Gas Diffusion Layer**
- **CL – Catalyst Layer**
- **Land region (L)**
- **Channel region (C)**
- **Carbon fibers**
- **Pore spaces**
- **Layer thickness = L**

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

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

\[
\varphi_{2D} = \frac{\text{Void area}}{\text{Total area}} = \frac{\text{Void area}}{\text{Void area} + \text{Solid area}}
\]

\[
\tau_{\text{gas-phase}} = \frac{\text{Actual path}}{\text{Shortest distance}} = \frac{\sum_{i,j} u_{\text{max}}(i,j)}{\sum_{i,j}|u_i(i,j)|}
\]

**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**

<table>
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<th>Time_step=100</th>
<th>U_{max}</th>
<th>Time_step=500</th>
<th>U_{max}</th>
<th>Time_step=2000</th>
<th>U_{max}</th>
<th>Time_step=4000</th>
<th>U_{max}</th>
<th>Time_step=10000</th>
<th>U_{max}</th>
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</thead>
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<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

**Average Velocity - Tortuosity**

- **Step = 100**
- **Step = 500**
- **Step = 2000**
- **Step = 4000**
- **Step = 10000**

**Gas-phase Tortuosity obtained at different time_step**

\[
\text{Porosity} = 0.7770
\]