# Miniature Fuel Cell Performance with Segmented Contacts

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Introduction: **:** PEMFCs are very promising for both mobile and mid-power stationary applications. . As Silicon used in the miniature fuel cell is not a good conductor of electricity, electrical contacts has to be attached to the GDL to draw power. Here we build a 3D model and 7 different ways of attaching the contacts to the GDL is studied using COMSOL Multiphysics.

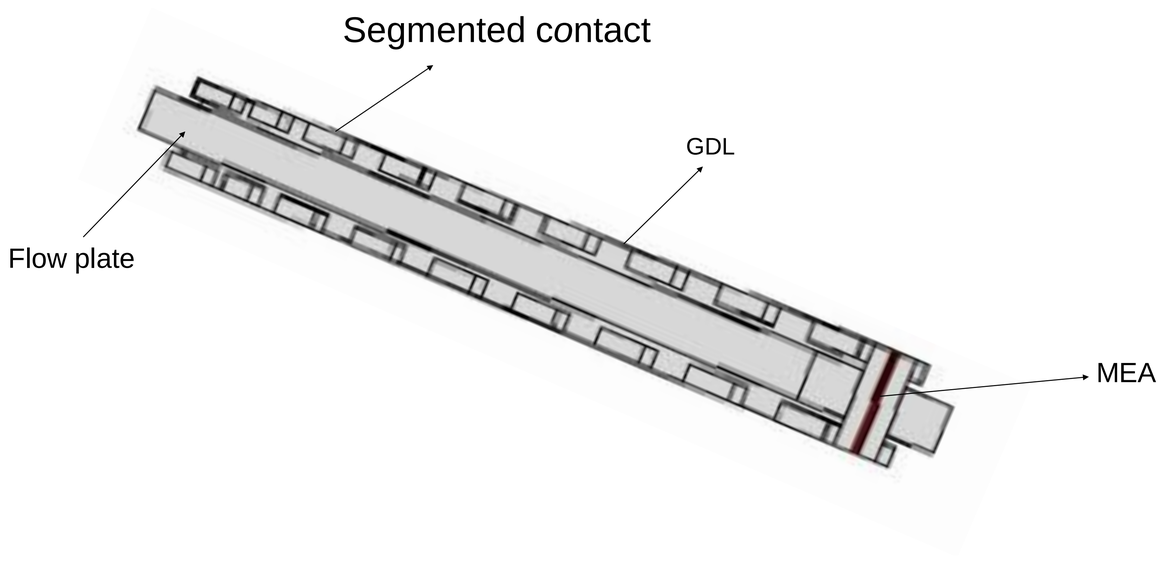


Figure 1.The schematic of PEM fuel cell model with 9 contacts

Computational Methods: Following three are the basis of the study:

1. Mass conservation or continuity equation (applies to the flow field plates, GDL and the catalyst layer)
2. Species conservation(Stefan-Maxwell diffusion equation)
3. Charge conservation (applied to the GDL, catalyst layer and the membrane)

Single phase steady state PMFC model is based on the following conservation equations

$$\frac{\partial(\epsilon\rho u)}{\partial t} + \nabla\cdot(\varepsilon\rho uu) = -\epsilon\Delta p + \nabla\cdot\left(\epsilon\mu^{eff}\Delta u\right) + S_u$$

$$\frac{\partial(\rho\in)}{\partial t} + \nabla\cdot(\epsilon\rho u) = 0$$

$$\nabla\cdot(\rho X_i u) = \nabla\cdot\left(\rho\sum_{j=1}^{n-1} D_{ij}^{eff}\nabla X_j\right) + S_i$$

$$\nabla\cdot\left(\sigma^{eff}\nabla\Phi\right) + S_\phi = 0$$

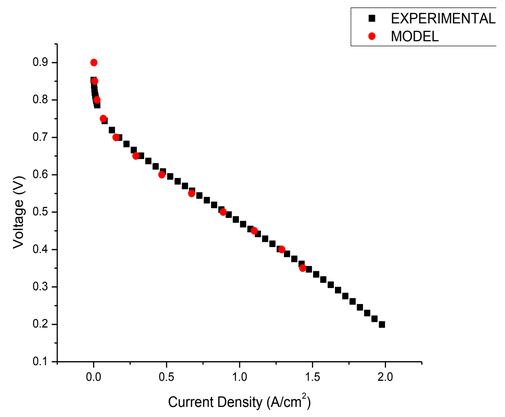


Figure 3. . Polarization plot for experimental and modelling results

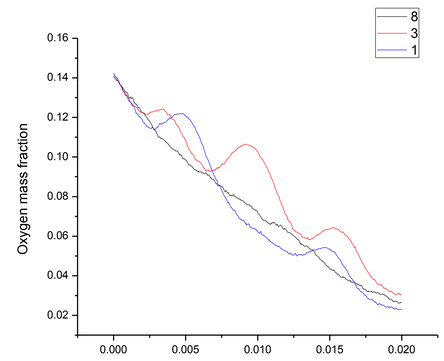


Figure 4. Mass fraction variation along the length in GDL

| Case | No of contacts (anode side) | Total Length of contact (anode side) | No of contacts (anode side) | Total Length of contact (anode side) |
|---|---|---|---|---|
| 1 | 3 | 0.66 L | 3 | 0.66 L |
| 3 | 4 | 0.5 L | 4 | 0.5 L |
| 4 | 5 | 0.625 L | 5 | 0.625 L |
| 6 | 5 | 0.625 L | 1 | L |
| 7 | 8 | 0.5 L | 1 | L |
| 8 | 9 | 0.41 L | 1 | L |
| 9 | 8 | 0.4 L | 1 | L |
| 10 | 9 | 0.375 L | 1 | L |

Table 1. Schemes of Current Collection

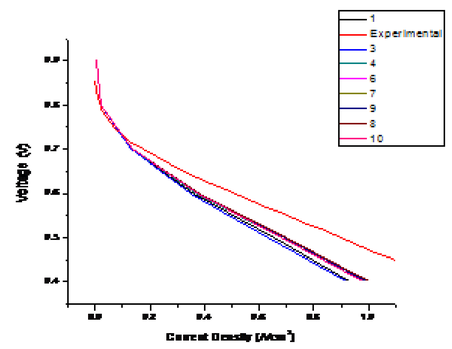


Figure 5. Performance curves for the cases in Table1

Conclusion: The gaps between the contacts reduce the local over potential in the electrode reducing the local current density. Reducing the gaps by segmentation reduce this effect. The gaps between the contacts reduce the local over potential in the electrode reducing the local current density. Reducing the gaps by segmentation reduce this effect.

References:

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