# Thermoplastic Bipolar Plates for PEM Fuel Cells

**NMITLI Program on Stationary PEMFC**

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## Motivation:

• Bipolar plates in Polymer Electrolyte Membrane (PEM) fuel cells account for up to 30% of the stack cost.

• Injection moulded thermoplastic composite bipolar plates promise significant cuts in cost and cycle time.

## Objectives:

• Thermoplastic/ Graphite system to be studied for electrical and mechanical properties following melt compounding and moulding.

• Scale- up of developed compounds to suit mass manufacturing using compression and injection moulding processes.

## Target:

• Electrical conductivity of around 100 S/cm (DOE standards)

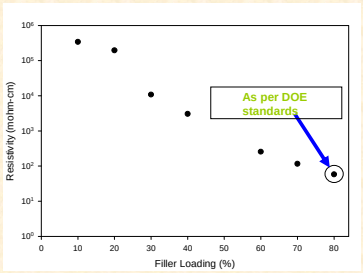
• No bending under stack loading conditions

• Excellent resistance to highly acidic environments

• Suitability for continuous operation at 100ºC

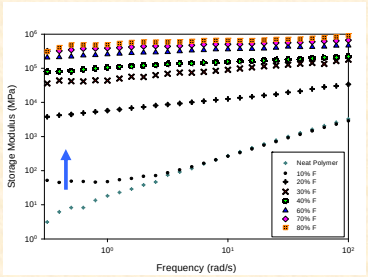
Sample formulations

| | Polymer Wt (%) | Graphite Wt (%) | Carbon Black Wt (%) |
|---|---|---|---|
| 1 | 90 | 8 | 2 |
| 2 | 80 | 16 | 4 |
| 3 | 70 | 24 | 6 |
| 4 | 60 | 32 | 8 |
| 6 | 40 | 48 | 12 |
| 7 | 30 | 56 | 14 |
| 8 | 20 | 64 | 16 |




Resistivity data

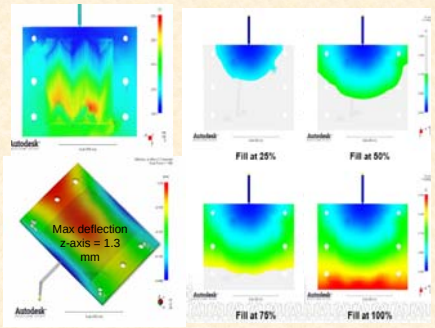
• Electrical percolation threshold at around 20% filler loading.




ARES Rheology data

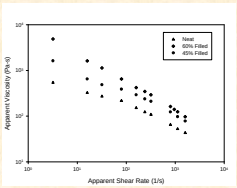
•Mechanical/ rheological percolation beyond 10% filler loading

Large Scale Compounding Trials

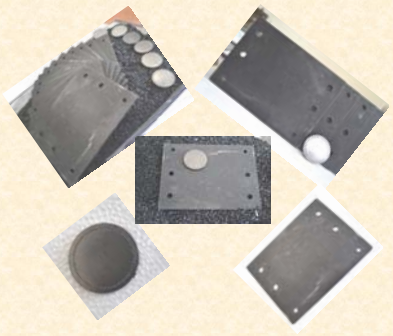



•Side gating with injection time = 0.3 s

•Predicted warpage = 1.3 mm




High shear rheology data



Resistivity for large scale formulations

| Filler Loading (%) | Rho (mohm-cm) |
|---|---|
| 77 | 20 |
| 71 | 60 |

As per DOE standards

## Conclusions and Future Work:

Successfully demonstrated injection moulding of 45 and 60% filled bipolar plates. The future work will focus on development of injection mouldable compounds with higher filler loadings.

## Acknowledgements:

•Reliance Industries Limited for small scale compounding trials.

•M/S Steer Engineering for large scale compounding trials.

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