European Fuel Cell Car Workshop | March, 1st - 3rd 2017, Orléans, France

Patterned Gas diffusion media for Polymer Electrolyte Membrane Fuel Cells

I. Biswas, P. Gazdzicki, S. Helmly, C. Schmitt, M. Schulze*
German Aerospace Center (DLR), Pfaffenwaldring 38-40, 70569 Stuttgart, Germany

*presenting author : Mathias.Schulze@dlr.de

Keywords: polymer electrolyte fuel cells, hydrophobicity, gas diffusion media, polytetrafluoroethylene, laser modification

Polymer electrolyte membrane fuel cells with their high gravimetric energy density face a water balance problem especially under variable loads, e.g. in automotive operation. The excess product water needs to be removed from the fuel cell while maintaining a humidified membrane.
The gas diffusion layer (GDL), which also provides contact to the electrochemically active components, is responsible for the internal passive water management of the cell. They typically consist of a conductive medium, a carbon based powder in the microporous layer (MPL) or carbon felt/fibres/cloth in the macroporous backing, and a hydrophobicity impregnation agent like polytetrafluoroethylene (PTFE). The ratio determines the overall hydrophobicity and a fine adjustment is crucial for performance and stable operation.
In the presented work, the MPLs were modified with laser irradiation to form a structured, non-uniform hydrophobicity, thus introducing more hydrophilic evasion pathways for water while maintaining more hydrophobic areas to assure sufficient gas transport to the catalyst. The effect of the modification is mostly due to a local removal of PTFE.
Appropriate modifications can result in considerable performance improvement, in particular under high loads, and more homogeneous current density.

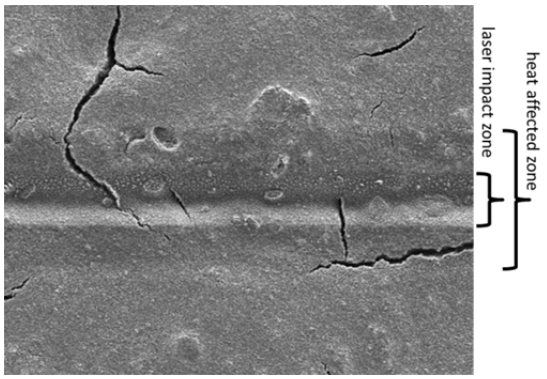

Figure 1: SEM image of a laser patterned microporous layer (~ 600x800 µm).

Acknowledgements
SGL Carbon is gratefully acknowledged for providing samples. We are grateful to Dr. Daniel Garcia for experimental support.
The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for Fuel Cell and Hydrogen Joint Technology Initiative under Grants No. 303446 (IMPALA) and No. 303452 (IMPACT).