Fuel Cell Gas Diffusion Layer

The innovative Gas Diffusion Layer (GDL) enhances the performance of fuel cells by preventing water accumulation in the MEA

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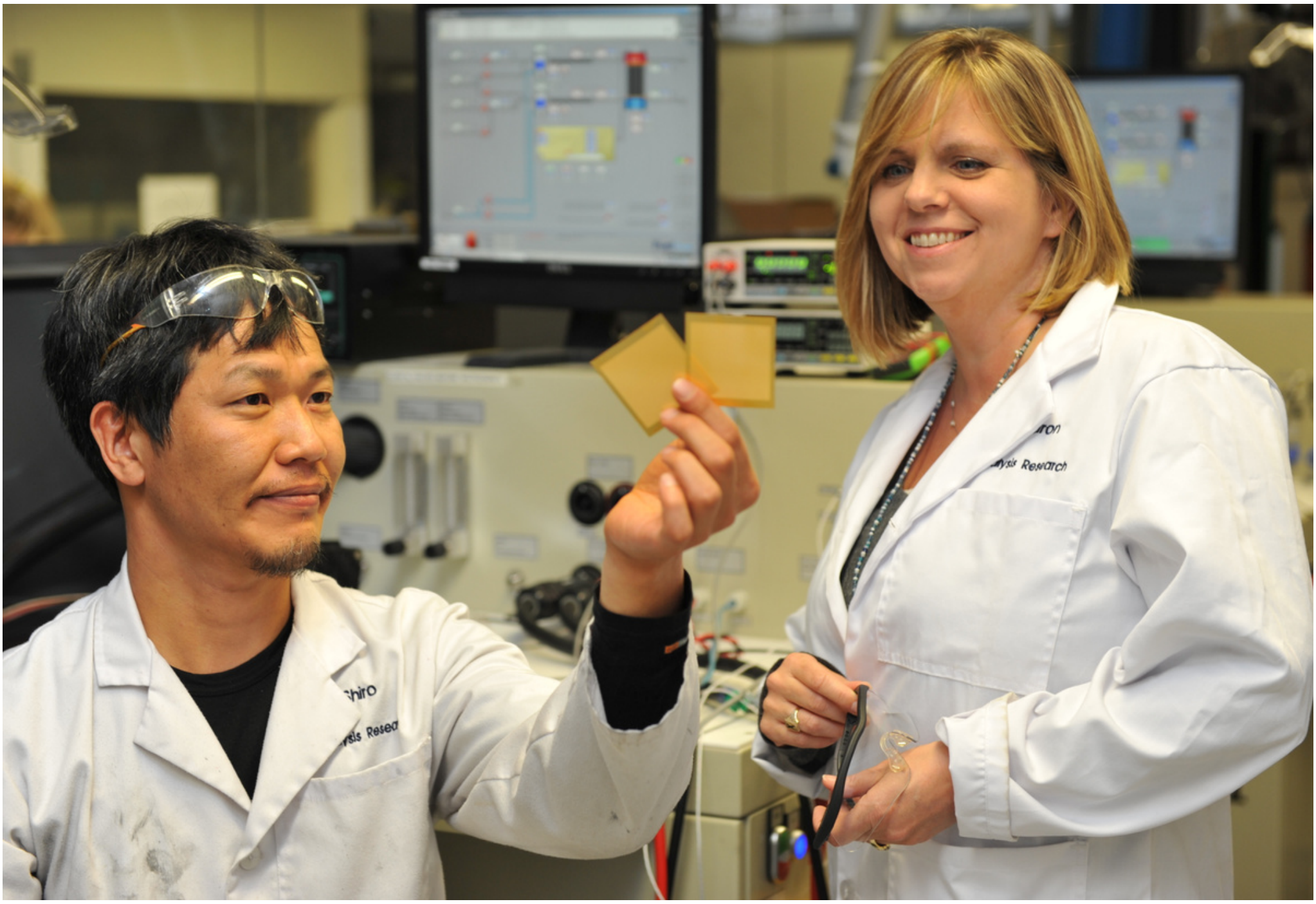

Header image provided by the university

Background

The gas diffusion layer (GDL) is a porous and electrically conductive material located between the catalyst layers and bipolar plates of a polymer electrolyte fuel cell. Its primary function is to provide pathways for:

1. reactant gases from the bipolar plate to the catalyst layer, and
2. product water from the catalyst layer to the bipolar plate.

The GDL also assists with heat removal and provides mechanical support to the membrane. To further improve both gas and water transport and enhance electrical contact with the catalyst layer, a microporous layer (MPL) is applied to the GDL.

Current commercial GDLs are made of randomly dispersed carbon fibers resulting in a very porous material with a random and wide pore size distribution. During fuel cell operation the porosity is reduced due to compression of the GDL and this leads to low gas permeability and poor gas distribution to the catalyst layer. Water can build up in the compressed pores leading to a phenomenon called GDL flooding. Flooding further prevents gases from reaching the catalyst layer.

Competitor GDL-MPL technologies have low thermal conductivity and electric conductivity because of the high porosity and use of carbon as the core material. This results in higher than desired temperatures in the catalyst layer and membrane which can under certain operating conditions lead to catalyst layer and membrane dry out. Their low rigidity leads to minimal compression of GDL areas in the “under-channel region”, resulting in poor contact with the catalyst layer, increased ohmic resistance and decreased fuel cell performance.

Technology Overview

In the UCT invention, a microporous layer is inserted between the GDL and the catalyst which prevents the accumulation of water, has ridges that promote the flow of water and enhances the rigidity of the GDL, resulting in more uniform pressure distribution. The MPL is constructed to fill the pores of the GDL and it enhances the diffusion of gasses to the catalyst layer and the design can easily be modified and tailored for different operating conditions and applications.

Specific details of tests and their outcomes are available in the patent specifications - that can be reached via the links below.

Use of the metal GDL also led to the development of a suitable gasket, which has also been patented.

Benefits

A microporous layer (MPL) is inserted between the catalyst layer and the metal GDL. This, along with the fact that the GDL is more rigid provides the following benefits:

- prevention of the accumulation of water at the interface of the catalyst layer and the GDL
- enhanced diffusion of the gasses to the catalyst layer
- lining of the pores of the GDL with the MPL material further reduce water accumulation and the formation of large water droplets.
- more uniform pressure distribution from the bipolar plate onto the catalyst layer and reduced contact resistances
- the metal GDL is thinner than conventional GDLs, which may reduce the height of the fuel cell stack

A specific configuration of holes in the GDL is provided to maximise the exposure to the channel area of the bipolar plate and the repeating pattern leads to better gas diffusion and more uniform gas supply to the catalyst layer. A pin can be used as an alignment aid and it is located in the active area of the MEA to ensure that there is no impact on the gasket and sealing system.

Applications

This metal gas diffusion layer (GDL) can be used in hydrogen fuel cells to enhance the performance of the membrane electrode assembly (MEA).

Opportunity

UCT is seeking to license or sell (assign) this IP to a commercial partner. The patent family includes granted patents in the USA and South Africa and applications in Europe and Canada that are still progressing through the examination process.

Patents

- PCT/IB2015/052332
- US Patent US10256492B2

IP Status

- Patented
- Patent application submitted

Seeking

- Commercial partner
- Licensing