

# SIGRACET® Fuel Cell Components

## Energy Conversion Systems with Future Potential

SGL Group – The Carbon Company – is one of the world's leading manufacturers of carbon-based products. Focusing on creating innovative solutions and value for our customers, we rely on our core competencies and on our Company philosophy of SGL Excellence.

We have a comprehensive portfolio ranging from carbon and graphite products to carbon fibers and composites. Our in-depth and broad knowledge of materials, our production expertise, and our extensive applications and engineering know-how enable us to offer customized solutions.

We have close relationships with our customers through a sales network that spans the globe supported by more than 30 production sites in Europe, North America, and Asia.

With regards to the fuel cell industry, we currently supply materials for Proton Exchange Membrane (PEM), Direct Methanol (DMFC), Phosphoric Acid (PAFC) and Molten Carbonate (MCFC) stacks. We continually explore opportunities within all fuel cell environments and applications.

In the Proton Exchange Membrane (PEM) stack, hydrogen or reformed hydrocarbons are converted directly into electrical energy and heat by an electrochemical reaction with atmospheric oxygen. This can be done at an electrical efficiency level as high as 60% and low emission levels, typically in the form of water vapor.

The manufacturing of these high-efficiency cells requires completely new technologies, to which SGL Group is wholly committed. This new technology offers great market opportunities, not only in the supply of households with energy and heat, but also in the field of portable applications. PEM fuel cells are proving highly



promising when used as drive units in buses and/or cars and fork lift trucks. First near-series products for domestic energy systems are available since 2006. This modern technology has the potential to bring lasting changes to the decentralized energy production market.

Drawing on its long-standing experience in the use of graphite in chemically aggressive environments and other media, e.g. in process equipment engineering, SGL Group began selecting materials for Gas Diffusion Layers (GDLs) – a key component of the stack – in the late 1990s.

SGL Group is thus among the few companies worldwide to undertake mass production of key components for PEM fuel cells. The quality of these graphite components is of eminent importance to the performance of the fuel cell.

**Broad Base. Best Solutions.**

## SIGRACET® Gas Diffusion Layers (GDLs)

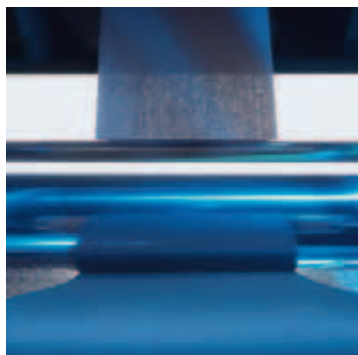
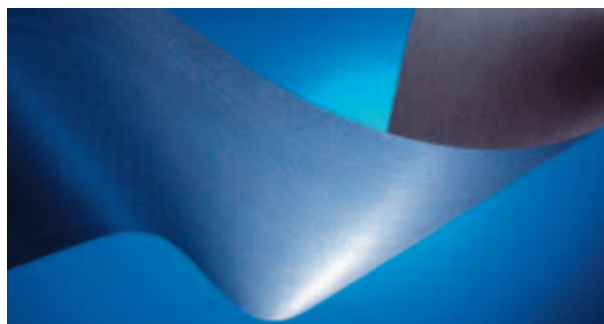
Right from the beginning of gas diffusion layer development in 1998, SGL Group has attached great importance to low-cost production. This means GDL production in continuous roll form. Our first GDL products are based on polyacrylonitrile (PAN) fibers and reach a thickness of about 0.4 mm after a number of oxidation and impregnation steps. GDL 10 is our first generation of GDL products. This material is relatively soft and displays high air permeability. It is therefore particularly suitable for use in systems with high humidity levels, such as domestic energy systems.

With the development of the fifth GDL generation (0.3 mm material thickness) and the fourth generation (0.2 mm thin material), paper-type GDL products based on carbonized fibers have been introduced to the market. These thin materials allow the overall stack dimensions to be reduced.

All products are manufactured in roll form 50 to 100 m in length and a standard width of 0.45 m leading to their consistent production quality. Besides being supplied in roll form, the material can also be die-cut to customized dimensions by means of special tools.

This requires compliance with specific geometries. The different substrates all have the capability to be hydrophobically treated and coated with a thin microporous layer on one side. As a result, efficiency levels can be increased significantly by up to 5% if suitable GDL materials have been chosen. Thus, our GDL materials considerably surpass the benchmarked products used previously by properly selecting types and hydrophobicity levels through consultation with SGL Group staff.

Typical standard grades for general applications are GDL 24/25 BC, GDL 10 BC and GDL 34/35 BC but through different hydrophobicity levels and materials with/without microporous layers, SIGRACET GDLs can cater to virtually all standard or special applications including niche markets.



### We cater for future needs as well

Drawing on its long-lasting production experience, SGL Group will continue to improve the quality of its products by systematically developing materials and technologies, and to open up further new applications by reducing production costs through economy of scales.

The success of fuel cell technology and its introduction to the market greatly depend on the component manufacturers' potential for cutting costs. We have already made a number of investments to this end and will continue to help substantially improve marketability through innovative technologies and high product quality.

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