// Characterisation of PEM components II

// MEASUREMENT OF TRANSPORT PROPERTIES (GDL)

Gas diffusion layers (GDLs) are a central transport medium in fuel cells. Gaseous and fluid media, the generated power and the generated heat are transported through the GDL as part of fuel cell operation.

At ZSW, the transport properties of GDLs can be comprehensively characterised. The characteristic variables for gas transport are permeability (in plane and through plane) and diffusivity. The electrical properties can also be determined under compression, in the same way that permeability can (see tension/compression testing machine).

Permeability

Permeability is the transport parameter for convective transport through porous media. The effective permeability of gas diffusion layers (substrate and microporous layer (MPL)) can be determined at ZSW both through plane and in plane.

For "through plane" permeability determination, the tools available include both a Gurley densometer as the recognised standard and a porometer, which additionally allows measurements at different pressure.

For "in plane" permeability measurement, a circular ring of the porous material is used, which allows permeability to be determined as a function of compression.

// STRUCTURAL ANALYSES OF COMPONENTS

Numerous methods are available for determining component structures. Three-dimensional imaging is possible using tomographic techniques (µ-CT). Furthermore, scanning electron microscopy (REM) and optical microscopy are available as established methods at ZSW.

// SCANNING ELECTRON MICROSCOPY

In addition to the examination methods described above, the surface element distribution and structure of gas diffusion layers and other fuel cell components can be investigated using scanning electron microscopy (SEM). Resolutions down to 10 nm are possible in this regard.

Element distribution (EDS)

With energy dispersive spectroscopy (EDS), based on SEM examination, can be used to precisely determine the element distribution in the uppermost surface layer (approx. 1 µm) and to determine the local distribution of hydrophobic and hydrophilic areas, for example.

Optical microscopy

Using a modern digital microscope system, the structure and surface properties of all cell components can be examined down to the µm scale. A special feature available at ZSW is that also 3D structures can be imaged and measured using specific techniques. This facilitates a multitude of different applications, such as examination of the precise shape of channels in flow fields and the characterisation of cracks in the microporous layer of a gas diffusion layer. Using a special lens with a large working distance, a good resolution can be achieved even when imaging through thicker transparent materials such as transparent flow field plates, allowing semi-transparent cells to be precisely examined during operation, for example.

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