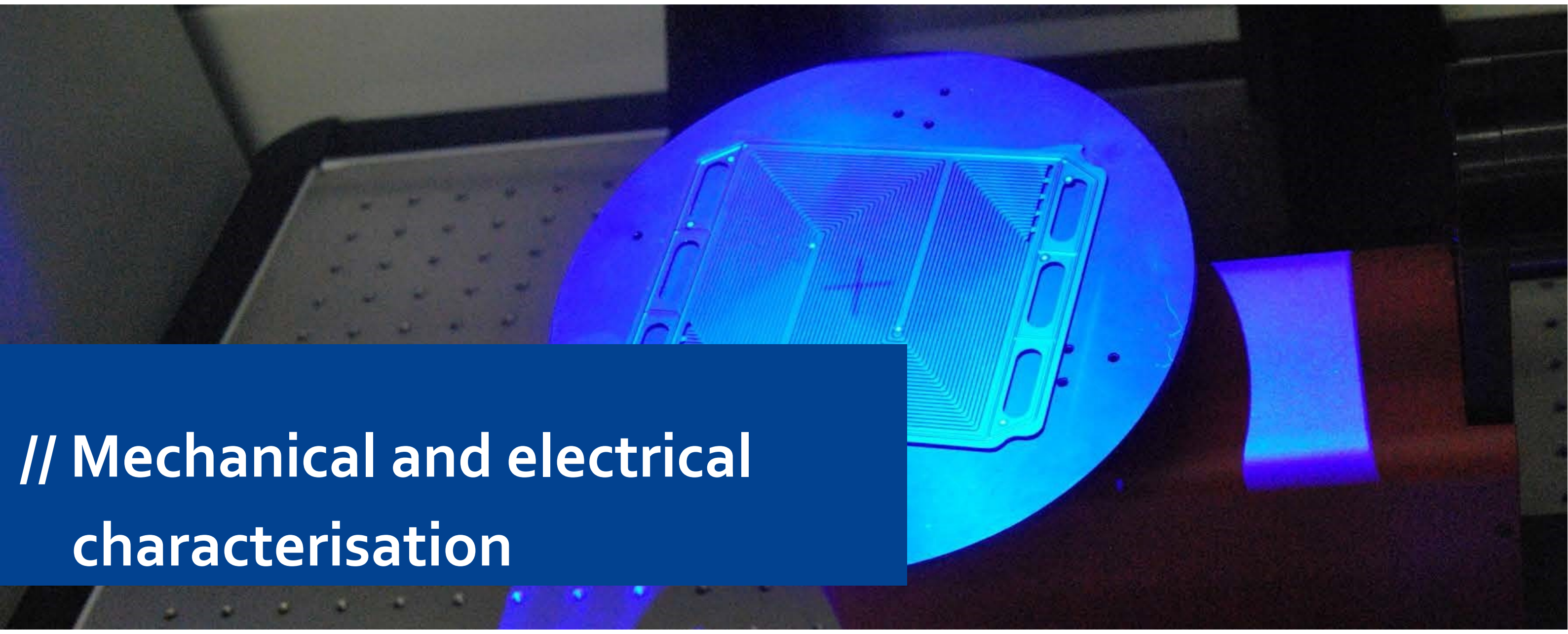


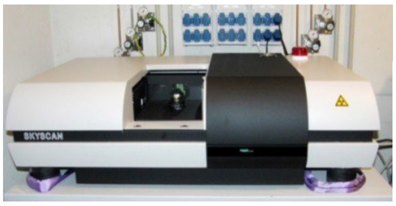
// Mechanical and electrical characterisation

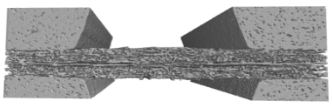
Mechanical and electrical characterisations include determination of the structure (e.g. by means of µ-CT), determination of properties under deformation, and characterisation of electrical properties. The methods available and their significance are presented in the following sections.

X-ray microcomputer tomography

The X-ray microcomputer tomography (µ-CT) available at ZSW can be used to comprehensively characterise gas diffusion layers (GDLs). In addition to structural analysis of a GDL at a high resolution, this includes the option to analyse GDLs under compression and at increased or reduced temperatures.

These findings can be used to determine the pore size distribution of the GDL substrate, for example. The structural information can be used as an input variable in determining the liquid water distribution to be expected based on the Monte Carlo method (MC). The structure of components assembly (including assessment of any defects) can also be examined using µ-CT.





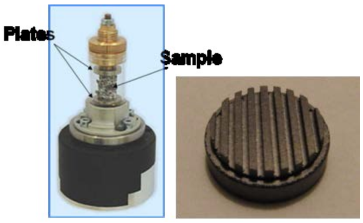


Fig. left: µ-CT for GDL characterisation, Fig. centre: GDL tomogram of compressed GDLs between gas distribution structure, right: Compression platform for "in situ" examinations using µ-CT

Tension/compression testing machine

Accurate knowledge of compression properties is essential both for the characterisation of gas diffusion layers and for adapting in appropriate of fuel cells. The force/displacement characteristics can be determined both under standard and customer-specific conditions.

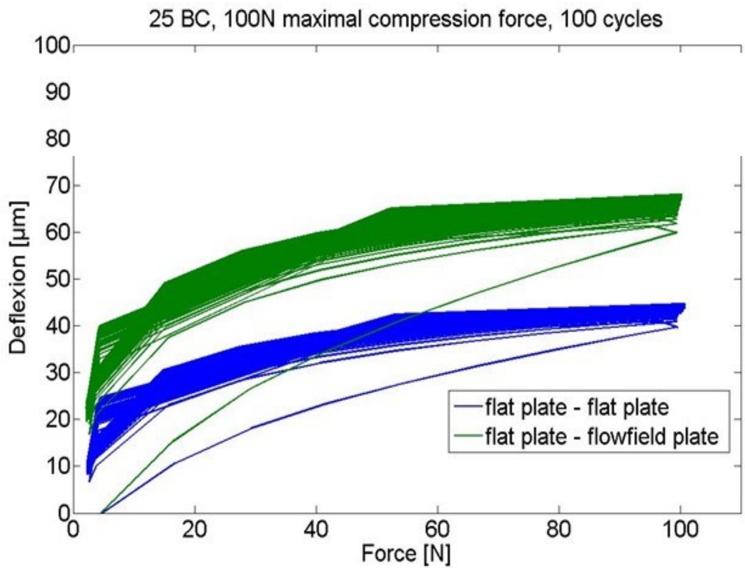


Fig.: Force-displacement curves of a gas diffusion layer with cyclic loading.

The tension/compression testing machine provides a flexible experimental platform, thus also further structural-mechanical measurements can also be performed on gas diffusion layers or e.g. bipolar plate materials. Traditional three-point bending to determine bending stiffness and repeated barrette bending experiments to determine the modulus of rigidity are particularly noteworthy in this regard.

Experiments to determine electrical conductivity as a two-pole or four-pole measurement are also performed in a tension/compression testing machine. This allows electrical conductivity – both through plane and in plane– to be determined as a function of compression.

Bending stiffness

A Taber® V-5 Stiffness Tester is used to determine the bending stiffness of materials e.g. for gas diffusion layers. In addition to bending stiffness, the elastic modulus and axial area moment of inertia can also be calculated from the bending moment determined.

Geometry tests and CAD matching

Very strict requirements for dimensional stability apply to gas diffusion layers, bipolar plates and the other mechanical components of a fuel cell. Dimensions can be determined at ZSW with a high degree of precision using a white light interferometer and µ-CT (see above).

White light interferometer

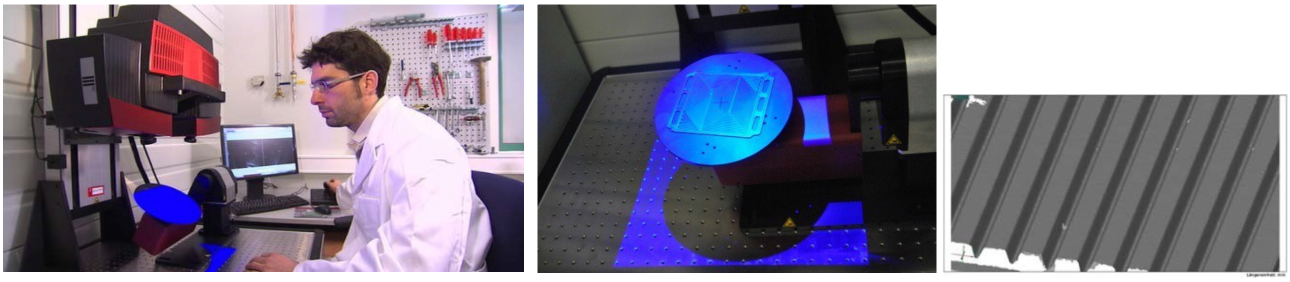


Fig.: Examination of fuel cell components using strip light projection.

The bipolar plates also play a decisive role with regard to proper performance of the cell. In order to ensure the functioning of the bipolar plates (media supply, media separation, geometry), measurable properties such as the channel depth, channel shape, plane parallelity and outer contour have to be checked after production. A high-resolution optical 3D digitiser is used for quality assurance for fuel cell components. This determines the component geometry of the bipolar plate, for instance, as a point cloud. This makes it possible to identify surface deviations from the CAD model, conduct interface analyses, and thus determine the production quality and possible areas for optimisation.

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