Contribution ID: **199** Type: **Oral Presentation**

Impact of compression on the properties of the fuel cell diffusion layer

Thursday, 2 June 2022 13:45 (15 minutes)

A fuel cell (FC) directly converts chemical energy from the oxidation-reduction reaction during which a transfer of electrons takes place between two chemical species into electrical energy. The powering off FC is supplied by continuous injection of hydrogen at the anode, and oxygen at the cathode. Continuous electrical energy is then available at the battery terminals. We will only focus on Proton Exchange Membrane Fuel Cells (PEMFC). FCs are expensive to remove and have a too low lifespan. Thus, reducing their cost and increasing their lifespan has become a challenge for many manufacturers. It was shown that the battery life depends on the degradation of the gas diffusion layer (GDL). In order to have a better understanding of the aging of GDL we simulated it mechanically using a compression bench to study its impact on the diffusion of water vapor through the GDL as well as the impact on its internal structure with the pore size distribution complementing with a visualization of GDL before and after aging with a scanning electron microscope (SEM).

We use a mechanical compression bench to simulate the mechanical aging of GDLs. The bench allows us to apply cyclic compression over several days to our GDLs in order to compare the properties of our GDLs before and after aging. GDL, due to its high porosity, is the element of the battery that is the most sensitive to mechanical stresses which will impact its performance. Studies have shown that GDL have an atypical mechanical behavior as the relationship between stress and strain is not linear.

The SEM serves us as the first visual comparison tool of our GDLs before and after aging. It allows us to confirm that the GDLs are indeed impacted by the compression cycles undergone as can be seen in image 1.

A dynamic vapor sorption device (DVS) which allows the measurement of sorption isotherms, is used to characterize gaz transfer in the GDL. The objective of the measurements with the DVS is to allow the determination of the coefficient of diffusion of water vapor through the GDL. We carried out these tests on new GDLs and old GDLs in order to determine if the mechanical degradation of the GDL had an impact on the diffusion through the GDL. For our tests we used a Payne cell to determine the diffusion coefficient of a membrane through 1D diffusion. The diffusion coefficient is then determined using the slope of the evolution of the mass versus time à the beginning of the process.
There is a decrease in the diffusion coefficient following the aging by mechanical compression of the GDL.

The charge / discharge cycles undergone by the FC were simulated using a mechanical compression bench which allowed us to demonstrate that the GDL is indeed impacted by the compressions initially thanks to the observation with the SEM and then thanks to the determination of the diffusion coefficient using the DVS which also varies at the end of a week of compression on our GDL.

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References

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

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