The PEM Fuel Cell Catalytic Layer Properties in Dependence of Deposition Method: High-capacity Printing as a Case Study

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Broad implementation of the hydrogen technologies into the daily life applications requires important changes in the currently used production technologies. Rapid and cost-effective manufacturing of the individual components is essential. This concerns also PEM type fuel cells and method of the catalytic layer deposition. Currently used technologies, like decal, slot die or spray coating are characterized by different operational characteristics defining their field of application. The issues they are facing concern mainly either slow production rate and/or inefficient catalyst utilisation caused by depositing the catalyst outside the active electrode geometry. An interesting, novel option represents industrial ink-jet printing. This technique is characterized by a high speed of deposition and, at the same time, precise dosing of the catalyst to the desired locations. It allows not only to cover exactly the active zone of the cell, but also gradient loading of the catalyst according to the corresponding reaction extent. Accordingly, this technique is recently attracting significant interest of the laboratories around the globe.

Interesting aspect of the application of ink-jet printing in the catalytic layer production represents properties of the resulting membrane-electrode-assembly (MEA). This contribution focusses on comparison of performances of MEAs produced by the ink-jet printing and by depositing ultrasonically dispersed catalytic ink of the identical composition on the surface of the membrane. To gain deeper understanding of the behaviour observed, FIB-SEM tomography was used to analyse internal structure of both catalytic layers. In the next step, their transport parameters were evaluated theoretically on the basis of replicas of structure from tomography images. Results of this analysis were validated experimentally by means of catalytic layer electron conductivity, as well as its permeability for gaseous reactants.

Present contribution provides a novel insight into impact of the catalyst deposition techniques on the internal structure of the active part of the fuel cell gas diffusion electrode and resulting performance of MEA.