

INVESTIGATION OF THE INFLUENCE OF MATERIALS PARAMETERS ON PEMFC PERFORMANCE USING THE CFD CODE AVL FIRE

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The investigation was aimed to analyze the influence of changes of single parameters (in sum 25 parameters) of the membrane, gas diffusion layer and catalyst layers on performance of polymer electrolyte membrane fuel cell (PEMFC). The simulations of PEMFC behaviors (at $T=70^{\circ}\text{C}$, $\text{RH}=90\%$, $p=1\text{atm}$) were carried out for three variations of each parameter using the CFD code AVL FIRE [1-2] with modified membrane transport model [3]. The current density dependencies of the cell potential, power density, membrane over-potential, mean water concentration in PEM, total water flux as well as relative humidity were analyzed in detail.

The study showed the variations of the membrane thickness and ionic conductivity results in visible changes of the membrane over-potential, it leads to alteration of polarisation curve slope. The variations of the water diffusion and electro-osmotic coefficients in PEM influence the total water flux, but lead to insignificant alterations of the voltage-current characteristics. The properties of the cathode catalyst layer affect substantially more the cell current density than of the anode catalyst layer. Among GDL parameters the most impacts are detected for GDL thickness, electrical conductivity and porosity. The increasing of the GDL porosity of 50% leads to dramatic drop (of 70%) of PEMFC current density, while decreasing the porosity increases the current density only of 10%.

[1] Manual AVL FIRE version 2010. Edition 11/2010. AVL List GmbH, 2010. 91 pp.

[2] Fink C., Fouquet N. // *Electrochimica Acta*. 2011. V. 56 (28). P.10820-10831.

[3] Karpenko-Jereb L., Innerwinkler P., Kelterer A.-M., Fink C., Prenninger P., Tatschl R. // *Procedia Engineering*. 2012. V. 44. P. 388 – 390.