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A One-Dimensional Numerical model of Carbon Corrosion in Catalyst Layers of Proton Exchange Membrane Fuel Cells

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The short lifetime of membrane electrode assemblies (MEAs) is one of the main obstacles for large-scale commercialization of proton exchange membrane fuel cells (PEMFCs). Carbon corrosion under certain transient operations such as start-up/shutdown and local hydrogen starvation can induce significant degradation of the catalyst layer, which will destroy the connectivity of carbon skeleton, cause collapse of the solid structures, change the wetting characteristics, increase the catalyst particle size, and reduce the cell performance. In order to accurately predict the lifetime of MEAs, a one-dimensional numerical model of carbon corrosion in catalyst layer (CL) is established in this study. It is found that carbon weight loss is about 4% after 2000 square wave potential cycles, and the numerical results are in good agreement with the experimental data. Besides, this study develops the quantitative relationship between carbon corrosion ratio and catalyst layer structural parameters such as carbon particle size, catalyst layer porosity and catalyst layer thickness. It is found that carbon corrosion has a significant effect on the structure of catalyst layer and will further increase the mass transport resistance of oxygen. It is demonstrated that an in-depth understanding of the carbon corrosion mechanism and the according structure evolution of the catalyst layer are of far-reaching significance to further improve the lifetime of the PEMFCs.

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Time Block Preference

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Participation

Online

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