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# Numerical Study on Response of Polymer Electrolyte Fuel Cell (PEFCs) with Defects under Different Load Conditions

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**Abstract :** Fuel cell is known to be an effective renewable energy resource which is commercializing in the present era. It is really important to know about the improvement in performance even when the system faces some defects. This study was carried out to analyze the performance of the Polymer electrolyte fuel cell (PEFCs) under different operating conditions such as current density, relative humidity and Pt loadings considering defects with load changes. The purpose of this study is to analyze the response of the fuel cell system with defects in Balance of Plants (BOPs) and catalyst layer (CL) degradation by maintaining the coolant flow rate as such to preserve the cell temperature at the required level. Multi-Scale Simulation of 3D two-phase PEFC model with coolant was carried out under different load conditions. For detailed analysis and performance comparison, extensive contours of temperature, current density, water content, and relative humidity are provided. The simulation results of the different cases are compared with the reference data. Hence the response of the fuel cell stack with defects in BOP and CL degradations can be analyzed by the temperature difference between the coolant outlet and membrane electrode assembly. The results showed that the Failure of the humidifier increases High-Frequency Resistance (HFR), air flow defects and CL degradation results in the non-uniformity of current density distribution and high cathode activation overpotential, respectively.

**Keywords :** PEM fuel cell, fuel cell modeling, performance analysis, BOP components, current density distribution, degradation
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