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Diagnosis of membrane chemical degradation for a health management system of polymer electrolyte fuel cells

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Due to increasing global energy consumption and carbon emissions from using fossil fuels as a primary energy source, low carbon electricity generation is increasingly important as society is shifting towards a more sustainable and electrified future to reduce carbon emissions and its effect on the environment. Polymer electrolyte fuel cells are a promising technology which can provide efficient electricity generation with zero carbon emissions. However, their reliability and durability are one of the main challenges to widespread commercialization. Improving these aspects is necessary for achieving lifetime targets. Diagnostics and prognostics are key components in a strategy to improve reliability and durability. The challenge of current methods to accurately model degradation and predict lifetime is highly complex due to the multiple interrelated degradation mechanisms. This research presents a diagnostic fuzzy inference system approach for health management of polymer electrolyte fuel cells. The investigation focused on the diagnosis of membrane chemical degradation as this was identified as a top priority. The fuzzy inference system facilitates the connection between operating conditions and subsequent degradation modes. An inference calculation is performed based on rules developed from fuel cell degradation knowledge without the need for complex mathematical models. This fuzzy diagnostic approach enables enhanced health management allowing for proactive decision-making thereby improving fuel cell reliability and durability. This increases fuel cell availability and lifetime resulting in a more valuable product. Fuel cell testing was conducted under various operating conditions known to cause membrane chemical degradation. Results support the proposed rules for the diagnostic fuzzy inference system.

Biography

Derek has completed his BEng degree in Renewable Energy and Sustainable Technologies from Glyndwr University. He has also completed his MSc degree in Renewable Energy Systems from Loughborough University within the Centre for Renewable Energy Systems Technology (CREST). He is currently in the third year of a four year PhD with integrated studies. His PhD research is part of a wider project in the Centre for Doctoral Training in Fuel Cells and Their Fuels which includes four other partner universities including the University of Birmingham, University College London, Imperial College London and the University of Nottingham.

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