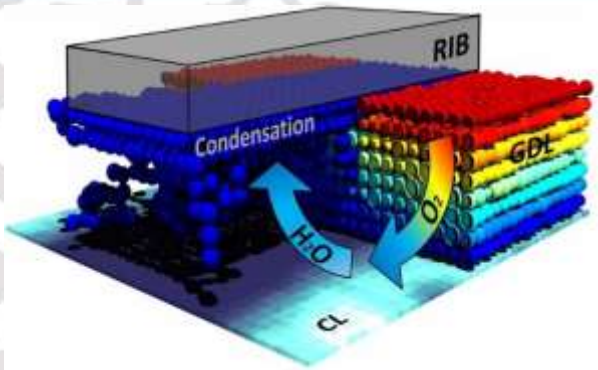

WATERY INSIGHTS COULD IMPROVE FUEL CELL PERFORMANCE

Jeff Gostick and Mahmoudreza Aghighi

WISE researcher Jeff Gostick can envision a day when clean, efficient fuel cells replace today's internal combustion engines. These eco-friendly energy generators run on hydrogen and air. Best of all, they produce no greenhouse gases — only water.

Fuel cells are ideal for consumer vehicle applications, due to their long range and quick refueling times, but lack of a hydrogen refueling infrastructure has delayed their deployment in favor of battery powered vehicles. This has not been a problem for commercial fleets though, and hydrogen fuel cells are being widely deployed in materials handling equipment like fork-lifts and delivery trucks which can fuel up at central, but private depots.

Right now, one of the hurdles facing PEM fuel cells is water management. When hydrogen ions reach the cathode, they combine with electrons and oxygen to form water. If that water is in gas form, the moisture helps keep the membranes hydrated. However, if it turns to liquid, it can flood the electrode — and that's bad news.

Gostick and his McGill collaborator, Mahmoudreza Aghighi, set out to better understand how and when liquid water forms at the cathode. They developed a pore network simulation and incorporated a sophisticated algorithm that takes into account heat, mass and electrical transfer.

The pair demonstrated their model successfully predicts the change from gas to liquid under different operating conditions. On top of that, it predicts where liquid water clusters will form within the cathode.

That's a significant improvement over existing models, creating important insights into condensation and evaporation in the electrodes. As a result, it paves the way to better water management in PEM fuel cells — and brings us closer to the day when we can ditch internal combustion engines.

Researchers: Jeff Gostick *and Mahmoudreza Aghighi*

Partners: *Natural Sciences and Engineering Research Council of Canada through the Collaborative Research and Development Program in partnership with the Automotive Fuel Cell Cooperation.*

Source*:* Aghighi, M., & **Gostick, J.** (2017). Pore network modeling of phase change in PEM fuel cell fibrous cathode. *Journal of Applied Electrochemistry*, 47, 1323–1338.

READ FULL ARTICLE