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Observation of Oxygen Removal in Polymer Electrolyte Membrane Water Electrolyzers

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This study aims to understand the fundamental processes that affect catalyst utilization and gas transport through the porous media in polymer electrolyte water electrolyzers (PEWEs) to optimize interfaces between the catalyst layer, porous transport layer (PTL) and membrane by using imaging techniques, simulations and characterization. PEWEs is a promising technology to produce green hydrogen with high efficiencies at low temperature. The widespread deployment of this technology is stifled today by high catalyst cost, high catalyst loadings and material properties that affect the complex two-phase transport processes consequently resulting in lower voltage efficiency. Currently, two major types of PTLs of varying morphologies (sintered Ti and fiber Ti) are commercially available but the correlation of their bulk properties and the effects of catalyst distribution that affect the gas transport and the cell performance are still topics of dispute. Many are attempting to develop micro-porous layers (MPLs) to improve contact between catalyst layer and PTL and also help remove oxygen from the catalyst layer. This study aims to understand oxygen distribution and performance, as well as durability of PEWEs with PTLs and those with MPLs developed by DeNora. We used x-ray computed tomography (CT) to quantify the interfaces and observe oxygen transport in the channels and within the PTL. Then, we address the question of how PTL morphologies can be tuned with respect to IrOx loadings to utilize maximum gas transport pathways at high current densities.