**Influence of Coating Method on Performance of Roll-to-roll Coated PEM Fuel Cell Catalyst Layers**

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**Extended Abstract:**

As production of fuel cell vehicles and power systems increases there is a need to understand the process science of fuel cell manufacturing. Industrial production of polymer electrolyte membrane fuel cell (PEMFC) electrodes will rely on continuous roll-to-roll (R2R) coating methods to meet the rates needed for mass production. There are a variety of coating methods that could be used to coat catalyst layers. The different physics of each method may result in different catalyst layer morphologies and performance. Here we present the results of a study comparing proton exchange membrane fuel cell catalyst layers coated using two R2R coating methods: slot-die and gravure. These two methods were selected because the physics of applying the liquid to the substrate is very different between the two cases. For catalyst inks this is found to be impactful because of the agglomerated nature of the catalyst particles in the ink.

For these experiments, Pt/C catalysts layers were coated directly onto carbon-fiber gas diffusion media to create gas diffusion electrodes (GDEs), without the use of a decal transfer process. These GDEs were assembled into membrane electrode assemblies (MEAs) by hot pressing to Nafion membranes. Electron microscopy was utilized to understand the influence of coating method on electrode morphology. These measurements showed that slot die coating resulted in smaller catalyst agglomerates than gravure coating. The smaller agglomerate size is likely due the flocculated catalyst being better dispersed by the higher shear rates of the slot die process.

In situ performance and other electrochemical diagnostics were used to determine the influence of coating method on catalyst layer electrochemical properties. We find that slot die coating results in higher proton conductivity. This is due to the smaller agglomerates of the catalyst layer decreasing the catalyst layer tortuosity compared to a gravure-coated electrode. We also find that the slot die-coated catalyst layers are less sensitive to humidity than gravure coated catalyst layers. This is due to the smaller catalyst agglomerate size leading to more of catalyst in contact with proton-conducting polymer, which decreases the dependence on liquid water for proton conduction. These two factors result in the slot die coated catalyst layers exhibiting higher performance than the gravure coated catalyst layers.

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