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Performance of Electrospun Catalyst Layer and Property of Electrospun Nafion Nanofiber

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Abstract Content:

Introduction and Background

Catalyst layer (CL) is the core part in fuel cell which has been the center of research and innovation in both academy and industry. From the review of the milestones and the state-of-the-art of the CL technology, the optimal CL structure at mesoscale is proposed. It is argued that the electrospun CL has the potential in approaching such optimal structure.

Approach and Methodology

The catalyst layer is fabricated via electro-spinning, and its performance and durability are evaluated and compared with that coated using the same carbon supported Pt catalyst. To better understand the effect of the nanofibers in the electrospun CL, Nafion nanofiber is electrospun and a device and procedure to measure its proton conductivity is developed.

Results

It is found that the electrospinning process is sensitive to both the ink composition and environment condition. Tight control of temperature and relative humidity is required. The electrospun CL exhibits superior performance than the sprayed one using the same type of catalyst. CL characterization indicates that increased Pt utilization, proper ionomer content balancing the proton and gas transport, are the major reasons for the improved performance.

The four probe setup can measure the proton conductivity of a single NafionTM nano-fiber with good repeatability and reliability. A non-monotonic dependence of proton conductivity on the nanofiber diameters in the range of 500 nm~ 2 μm is revealed. A transition from percolation mechanism to aligning effect as the diameter decreases is postulated as the reason for this behavior.

Summary and Conclusions

The electro-spun CL shows better performance and durability than the coated one with the same carbon supported Pt catalyst, due to increased Pt utilization, less ionomer content, and superior proton conductivity. The electrospun Nafion nanofiber exhibits a non-monotonic change in conductivity as the diameter decreases, which is postulated to the change of conduction mechanism.