Center for Fuel Cells (CFC)

University of South Carolina, John Van Zee, Director, 803.777.2285, vanzee@cec.sc.edu

Center website: http://174.143.170.127/iucrc/publicFactSheetServlet?centerId=63

MacMullin Number for PEMFC Gas Diffusion Media

For proton exchange membrane fuel cells (PEMFC), the porous media of interest has been commonly referred to as gas-diffusion media (GDM) and used as gas-diffusion layers (GDL) in the assembly of the unit cell, even though this media is critical for transport of liquid water as well as gases. A simple technique consisting of a four-electrode system, which uses a square-wave form of current, was developed for measuring the MacMullin number for GDM. The MacMullin number relates the free-stream properties with the actual liquid and gas transport in the GDM. This ratio was successfully measured for different carbon-cloth and carbon-paper GDM, for which, in the absence of information for PEMFC, the Bruggeman expression has been commonly used to correct the free stream properties for the actual path length.

Fuel cell vehicles are one example of a potential application. Photo courtesy of GM.

This technique helps to understand critical properties of gas diffusion media that impact directly the liquid water and gas transport in fuel cell and electrolyzers. It includes assessing the length through which these phases travel. Previously, only measurements of the porosity were used to characterize the GDM and still product data sheets only use porosity. Mathematical models for fuel cell and electrolyzers are also improved by the use of the actual path length that leads to more accurate calculations on liquid and gas transport through the GDM.

Economic Impact: This technique allows for the scientific community to understand that the Bruggeman equation is not valid for carbon paper GDM and that a different relationship exits as a result of the differences in the path length created by the orientation of the fibers in each type of GDM. It provides industry the knowledge to improve the design of GDM and reduce their cost. It is leading the industry to consider the path length for liquid and gas transport as part of their research. This benefits the development of the fuel cell and electrolyzer technologies by provid-

ing optimum designs that improve the efficiency of these devices. This is a significant step forward for moving these technologies from a niche market into a broader market.

For more information, contact John Van Zee, 803.777.2285, vanzee@cec.sc.edu.