# Performance Testing of High Temperature Membrane Electrode Assemblies for PEM Fuel Cells

by

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# ABSTRACT

In today's society, ever more emphasis is being placed on the development of clean, green energy. One leading area of promise is Polymer Electrolyte Membrane (PEM), also called Proton Exchange Membrane, fuel cells. One of the main challenges facing PEM technology is manufacturing. Currently, it takes a great deal of time and energy to manufacture fuel cells, and the materials are expensive and difficult to make. In an effort to drive this price down, the manufacturing processes are being optimized using a number of Design of Experiments (DOE), including two described in this work. These DOEs examine a number of parameters involved in the sealing process using two machines, a thermal press and an ultrasonic welder. The thermal sealing DOE examined (1) sealing temperature (2) percent compression (3) sealing time and (4) manufacturer-specified post-processing after sealing on the fuel cell performance. The ultrasonic DOE examined (1) energy flux (2) sealing pressure (3) booster amplifier (4) anvil support material and (5) post processing after sealing and their effect on the fuel cell performance. Polarization behavior during single cell operation was examined and used as performance parameters in an ANOVA analysis. This ANOVA revealed the statistically significant input factors for the thermal sealing process and the ultrasonic sealing process. The polarization curves themselves were examined, and the different sources of loss inherent in the MEAs made in these DOEs were discussed. Finally, the design and development of a 10 cell stack assembly was described and discussed. This 10 cell stack is important to the future testing capabilities of the CATS Lab as MEA performance in a stack environment is critical to the successful completion of the Department of Energy funded grant work.