# *In situ* Temperature Distribution Measurement in an Operating Polymer Electrolyte Fuel Cell

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Knowledge and prediction of the temperature distribution in an operating polymer electrolyte fuel cell (PEFC) is a critical component to the complete understanding of PEFC water management. This is because at typical PEFC operating temperatures of around 80$^{o}$C, each degree centigrade variation in temperature changes the water saturation vapor pressure by approximately 5%. Therefore, a few degrees temperature variation along the MEA may have a profound effect on localized flooding. In addition, various other phenomena may be strongly coupled to thermal transport such as low power instability, system longevity, and cold start response. Study of these complex phenomena requires detailed knowledge of temperature distribution.

Unfortunately, the two-phase nature of the reactant and product flow precludes the direct insertion of thermocouples within the gas channel or gas diffusion layer. In this presentation, a new method to directly measure the temperature within a PEFC electrolyte with micro-scale embedded thermocouples will be discussed. Figure 1 shows a plot comparing the temperature of the bipolar plate to that of the membrane with an embedded micro-thermocouple during transient cell cool-down. So far, up to 10 micro-thermocouples have been embedded in a 50cm$^2$ membrane electrolyte assembly. Suitable fuel cell performance over a wide operating range has been demonstrated with the minimally intrusive thermocouples. The technique developed to manufacture the micro-thermocouples and embed them within the electrolyte will be discussed and the latest results will be presented. The results of this study can be used to provide a new tool for PEFC analysis.

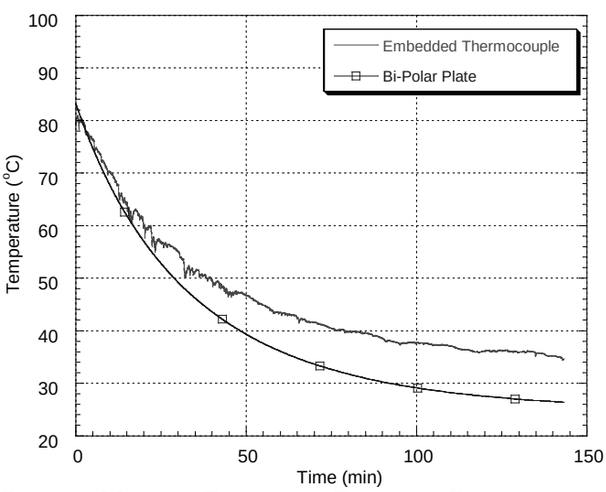


Figure 1. Measured Temperature Trace from Embedded Micro-thermocouple During Cell Cool-Down