High Temperature PEM Electrolysis

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Hydrogen generation by water electrolysis is generating more interest for fuel cell electric vehicles, back-up power and energy storage for renewable power sources. Alkaline electrolysis has long been the preferred method for large-scale electrolysis due to the low cost of materials (especially catalyst) and long track record. Polymer electrolyte membranes (PEMs) are beginning to penetrate this market due to their much higher current densities (>2A/cm^2), subsequent smaller footprints, and very high (5000 psi) and differential (5000 psid) pressures. The detriments to PEM electrolysis are similar to those of PEM fuel cells; slow oxygen kinetics, expensive catalysts, and a perfluorinated sulfonic acid-based membrane (PFSA) that generally limits operation to <80°C.

Improved PFSAs membranes with better mechanical and chemical durability have been actively pursued by the automotive industry to increase operating temperature for better kinetics, and more importantly heat rejection. These same improvements can increase PEM electrolysis performance, by reducing the oxygen electrode kinetics and improving membrane conductivity. Our results of operating PEM electrolyzers at high temperature (≥95°C) are shown, and compared to high temperature fuel cells.

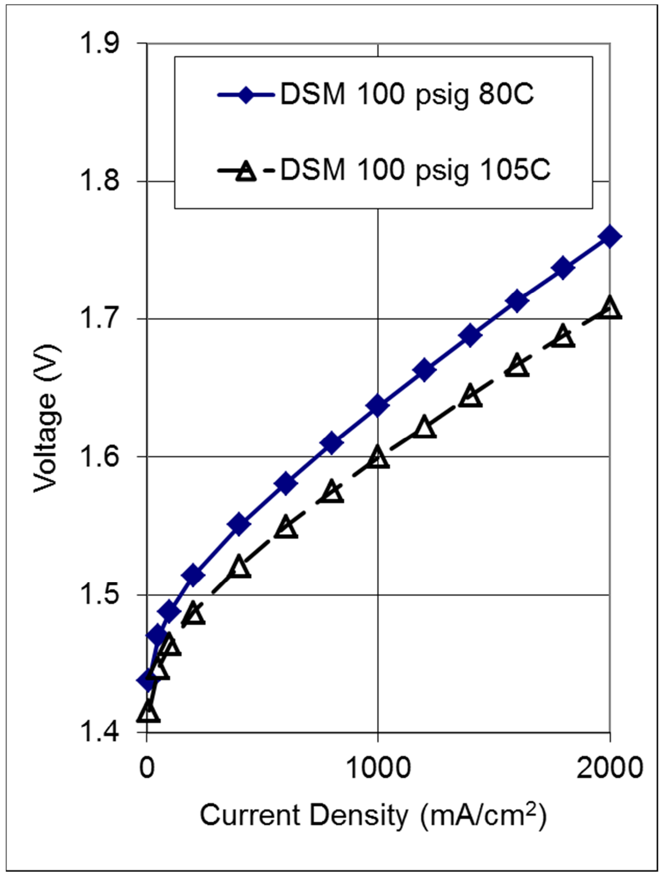

Figure 1. Giner, Inc.'s Dimensionally Stable Membrane (DSM™) electrolyzer performance at 150 psig at 80 and 105°C.