Catalyst and MEA Characterization for PEMFC Cathode Operation

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Catalyst characterization is critical to optimize PEMFC cathodes for automotive use. The two most popular methods of characterization are Rotating Disc Electrode[1] and MEA performance analysis[2-3]. Conditions of testing are critical to effectively predict fuel cell performance. Mass and area-specific activity are known ways to quantify electrode performances. However the conditions of testing and methods of MEA preparation vary from group to group (Table 3, Ref 2). To compare data to literature values, in such a scenario, becomes tedious.

Current methods of MEA preparation are either proprietary or not optimized well enough to effectively correlate catalyst characterization results obtained from the liquid electrolyte systems. This current work will feature

1. a standardized method to characterize catalysts in liquid electrolyte and fuel cell environments.
2. oxygen reduction reaction activities obtained on a mass-specific current density basis, and compare Pt utilization in MEAs and high surface area catalysts as shown in Figure 1. Figure 1 compares the cyclic voltammograms obtained in a liquid electrolyte system and on an MEA, both obtained at ambient pressure and temperature. To compare with a liquid electrolyte system, conditions in the MEA testing were maintained at 100%RH.
3. mass activity for oxygen reduction [A/mg_{Pt}] at 0.9V in $HClO_4$ and MEAs showing good agreement.
4. effect of platinum particle size in the catalysts used in MEA testing.
5. platinum utilization in catalysts obtained in thin film electrode in aqueous acid and in MEAs.

References:

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Figure 1: Comparison of cyclic voltammograms in mass-specific current density [A/g_{Pt}] format for Pt/C (46.1wt% Pt/C obtained from TKK) acquired in a glassy-carbon Disc Electrode setup in 0.1M $HClO_4$ (0RPM) and on a fully-humidified MEA (Counter electrode H_2-1000 sccm /working electrode N_2-1000sccm). Measurements were made at ambient temperature (20-22 °C) and pressure. Scan rates were at 20mV/sec.