CARBON SUPPORTED ELECTROCATALYSTS FOR DIRECT METHANOL FUEL CELLS

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In recent years, there has been significant work in the area of direct methanol fuel cells (DMFC) for portable applications. Electroactivity at the anode has been one of the biggest challenges in this area due to the slow kinetics of the methanol oxidation. However, with increasing demands on the power density requirements for DMFC for consumer applications, the performance of the cathode plays an important role too. Methanol crossover and electrolyte clogging of water results in a limiting effect on cathode performance, particularly when using Nafion® as the proton conducting membrane [1]. Most literature reports in the DMFC area exists on unsupported electrocatalysts because membrane electrode assemblies (MEA) were fabricated using catalyst loading levels above 4mg/cm² total metal, and most commercially available supported catalysts contain less than 40% metal loading, which would result in a very thick electrode layer and increased resistive losses [2, 3]. Some work done on supported electrocatalyst clearly shows that DMFCs utilizing supported electrocatalysts use less Pt than the unsupported catalysts [4]. High Pt utilization is important in reducing costs associated with commercializing DMFC technology. This paper discusses the performance of new supported electrocatalysts for improved DMFC performance at loading levels of ≤4mg/cm² total metal.

SMP has demonstrated a highly reproducible, high volume electrocatalyst powder manufacturing process capable of achieving excellent control over dispersion, composition and microstructure of various electrocatalyst formulations in the PEM and DMFC area. The SMP electrocatalyst powder production system is based on a spray pyrolysis configuration, where a feedstock comprising a liquid containing dissolved non-volatile precursors and suspended solids are atomized to form droplets and the droplets are heated to form powders. Through control over the temperature and time history during the processing of the droplets, the characteristics of the final particles such as microstructure, morphology, crystallinity, catalyst dispersion and porosity can be controlled.

Most DMFC data in the literature are reported for high temperature, and forced gases, mainly oxygen supplied to the cathode. These operating conditions are not possible in a fuel cell based portable power system. For a portable power system to be practical, high power density must be achieved at ambient pressures and temperatures. The work reported here was done in collaboration with Motorola’s Energy Technologies Lab, which has previously demonstrated a prototype 100 mW DMFC system for portable electronic devices. The performance of SMP supported Pt and PtRu electrocatalysts have been evaluated in air breathing and forced air substrates at Motorola. MEAs were prepared using a range of catalyst loadings. Since the ionomer plays a very important role in the DMFC performance [5] the electrode structure was optimized with respect to the ionomer and catalyst ratio. The performance is further compared to existing commercial unsupported catalysts.

References: