Catalyst Microstructure Examination of MEAs with Time in PEMFCs

Xuan Cheng, Ling Chen,[*] Cheng Peng,[*] and Ying Zhang[*]

Department of Chemistry, State Key Laboratory for Physical Chemistry of Solid Surfaces
[*]Department of Materials Science & Engineering
Xiamen University, China

Qinbai Fan

Gas Technology Institute, Des Plaines, IL 60018, USA

A series of single-cell tests under different time periods, namely, 200, 500, 700 and 1000 hours were operated in proton exchange membrane hydrogen-air fuel cells. A group of reproducible and identical membrane electrode assemblies (MEAs) were used for each test. The cell performance was studied by examining the cell polarization curves. After various lifetime tests, each MEA was cross-cut and characterized by XRD, TEM, SEM and Raman techniques to investigate any changes of structure and morphology, as well as the particle size and chemical compositions of catalysts in MEA. The average particle sizes of catalysts were calculated from XRD results and found to increase with the cell operation time after various tests. In addition, the agglomeration in nanometer-sized catalyst particles was observed from TEM analysis after the prolonged cell operation. Metal oxides were identified by Raman spectra from the anode catalyst of the tested MEAs, while no oxides were found from the cathode catalyst at the operating voltage. It is possible that the formation of metal oxides at the surface of anode catalyst led to the growth of larger particle sizes and ultimately resulted in the decrease of the catalyst activity, which might be responsible for the slight degraded cell performance after more than 700-h operation.

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