FESC
Florida Energy Systems Consortium

Florida State University

Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles

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Description: The objective of this project is to provide an innovative approach to revolution of current energy storage and conversion technology and greatly leverage FSU position in the strategic important area for sustainable energy. The project was performed by Drs. Jim Zheng and Richard Liang at the Department of Electrical and Computer Engineering and Department of Industrial Engineering, respectively. First to demonstrate preliminary results in high performance of energy storage and conversion materials and devices in order to seek outside funding consistent with the vision of IESES. The deliverables were conference proceedings and journal papers and proposal submissions for additional funding.

Budget: $15,000
University: FSU
Research Integration (collaboration): NCSU and NHMFL, Industrial Engineering, Maxwell Technologies, Inc. and Ionova Technologies, Inc., CAPS, MARTECH, Shanghai Institute of Technical Physics

Executive Summary

The catalytic electrode was developed using carbon nanotube film (buckypaper) as a supporting medium through use of the electrodeposition method. Buckypapers are free-standing thin films consisting of single-walled carbon nanotubes, carbon nanofibers held together by van der Waals forces without any chemical binders. Mixed buckypapers may be developed by layered microstructures with a dense and high-conducting SWNT networks at the surface, as well as large porous structures of CNF networks as supports. This unique microstructure may improve Pt catalyst accessibility and the mass exchange properties. Pt particles were uniformly deposited in porous buckypaper and had an average particle size of about 6 nm. A promising electrochemical surface area of about 40 m2g-1 was obtained from these electrodes.

Due to their unique microstructure, buckypaper-supported platinum (Pt) catalysts derived from carbon nanotube and carbon nanofiber have demonstrated a high utilization in proton exchange fuel cells. The durability of a buckypaper-supported catalyst was investigated using an accelerated degradationtest in a mimic cathode environment of PEMFC. Compared to commercial carbon black-supported buckypaper showed better catalyst durability after holding at 1.2 volts for 400 hours; specifically, almost 80% of electrochemical surface area was lost for carbon black, while only 43% loss for buckypaper. Transmission electron microscopy and cyclic voltammetry were used to study the Pt degradation mechanism. It was concluded that Pt coarsening and detachment from buckypaper support due to carbon corrosion make the major contribution to the Pt surface area loss under this condition. It is supposedly due to the higher corrosion resistance of buckypaper because of its high graphitization degree which is indicated by a slower formation rate of surface oxides in buckypaper than in carbon black.

This project has been completed.