Novel Approach to Non-Precious Metal Catalysts (New FY 2004 Project)

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Objectives

- Reduce the dependence of proton exchange membrane (PEM) fuel cell catalysts on precious metals.
- Achieve performance comparable to precious metal catalysts used in currently commercialized membrane electrode assemblies (MEAs) at a cost 50% less compared to a target of 0.2 g Pt/peak kW.
- Target demonstrated durability of greater than 2,000 hours with less than 10% power degradation.

Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- O. Stack Material and Manufacturing Cost
- P. Durability

Approach

The objectives of this project are to reduce the dependence of PEM fuel cell catalysts on precious metals in order to reduce the cost of the fuel cell stack as well as the overall system cost without loss of current performance or durability. The target is to develop catalysts that perform at least as well as the conventional precious metal catalysts currently in use in commercialized MEAs and that cost 50% less compared to a target of 0.2 g Pt/peak kW. The target for catalyst durability is greater than 2,000 hours with less than 10% power degradation.

The proposed work is directed at meeting these objectives while taking into account that the total costs of the catalysts include the processing costs for their synthesis and integration into an MEA. Several innovative technology approaches will be combined for synthesizing new non-precious metals and their support particles by process methods that also simultaneously disperse and coat the catalysts onto high-volume compatible substrates for low-cost integration into MEAs. The proposed candidate non-precious metal catalysts are based on the latest advances in fundamental understanding of the most promising areas of cathode catalyst development in the world. Sound scientific evidence from published data has been used to identify a new class of potentially active multi-element chemical centers for oxygen reduction. Two process methods, new for this purpose, will be investigated for synthesizing these new materials and applying them onto a 3M proprietary, high surface area, catalytic support system, compatible with high-volume roll-good processing of MEAs. The approach takes advantage of recent advances in 3M cathode catalyst development, which have significantly reduced the precious metal content of Pt-based ternary catalysts.

The proposed work is divided into two principal tasks. The first task is focused on development of the required new material properties. This will be accomplished through extensive catalyst fabrication

and performance screening to obtain correlations of the material composition and structure characteristics with the desired electrochemical properties on the one hand and the various process parameters on the other. The second task is focused on scale-up of the materials and processes to demonstrate the feasibility for high-volume production and generate large area MEAs for PEM fuel cell stack testing. The proposed work covers a 3-year period.