Spraying Techniques for Large Scale Manufacturing of PEM-FC Electrodes

by

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ABSTRACT

Fuel cells are highly efficient energy conversion devices that represent one part of the solution to the world's current energy crisis in the midst of global climate change. When supplied with the necessary reactant gasses, fuel cells produce only electricity, heat, and water. The fuel used, namely hydrogen, is available from many sources including natural gas and the electrolysis of water. If the electricity for electrolysis is generated by renewable energy (e.g., solar and wind power), fuel cells represent a completely 'green' method of producing electricity. The thought of being able to produce electricity to power homes, vehicles, and other portable or stationary equipment with essentially zero environmentally harmful emissions has been driving academic and industrial fuel cell research and development with the goal of successfully commercializing this technology.

Unfortunately, fuel cells cannot achieve any appreciable market penetration at their current costs. The author's hypothesis is that: *the development of automated, non-contact deposition methods for electrode manufacturing will improve performance and process flexibility, thereby helping to accelerate the commercialization of PEMFC technology*. The overarching motivation for this research was to lower the cost of manufacturing fuel cell electrodes and bring the technology one step closer to commercial viability.

The author has proven this hypothesis through a detailed study of two non-contact spraying methods. These scalable deposition systems were incorporated into an automated electrode manufacturing system that was designed and built by the author for this research. The electrode manufacturing techniques developed by the author have been shown to produce electrodes that outperform a common lab-scale contact method that was studied as a baseline, as well as several commercially available electrodes. In addition, these scalable, large scale electrode manufacturing processes developed by the author are also flexible and can be used to fabricate almost any fuel cell electrodes on the market today. This dissertation provides a description of the entire electrode manufacturing process as well as an analysis of the accuracy, performance and repeatability of the methods.