Analysis Technologies for Continuous Electrocatalyst Layer Fabrication: Future Expectations and Possible Approaches

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Fuel cells are of huge interest to the technology marketplace, as illustrated by sizable investments in the technology and market capitalization of fuel cell companies. The overall market size for fuel cells is deemed to grow beyond that of transportation and stationary power into distributed power, to an estimated $1B to $200B annually by 2025. In a very real way, fuel cells will be to energy what integrated circuits have become to information.

Crucial to the IC revolution were the tools required to mass produce ICs, therefore breakthroughs in mass production and quality control can be also be expected for fuel cell viability. The metaphor can be extended to compare the role that thin films play in semiconductor device fabrication and the vital role that the electrocatalyst layer plays in fuel cell operation.

A variety of processes are being utilized or are under development for the mass production of membrane electrode assemblies, where the key step is the application of the electrocatalyst layer either on the ionomeric membrane or the gas diffusion media. Regardless if the process is spray deposition or screen printing or vapor deposition or decal transfer, all mass production processes will require Quality Control.

This presentation will outline an expectations of the industry's QC needs. Some major questions that will be addressed are:

- What are acceptable figures of merit?
- What are the speed / complexity limitations?
- What is the development timeframe?

A projection of possible measurement technologies can be made from considering the product specifications and the issues addressed above.

A great number of possible on-line and at-line analysis techniques exist that qualify and/or quantify various aspects of the composite electrocatalyst layer. The key question that arises in building a QC process is how well and how reliably does the figure of merit produced track product performance.

The following analysis techniques are all relevant to electrocatalyst layer composition:

- X-ray fluorescence
- X-ray diffraction
- electron microscopies
- microanalytical techniques
- thermal gravimetric analysis
- infrared spectroscopy
- temperature programmed desorption.

Obviously not all of these techniques will be amenable to production QC, but all have some impact on deriving the performance → characterization map.

In addition to a comprehensive overview of the QC needs and possibilities for electrocatalyst layer production, this talk will also present some of the recent work at MicroCoating Technologies. MCT is developing on-line, continuous methods to quantitatively follow ionomer structure and Pt-CO interactions using both FTIR and TPD measurements. The ultimate expectation is to produce a simple, on-line, continuous quality control process that provides a reliable correlation to electrochemical performance.