Hydrogen and Fuel Cell Technical Highlights

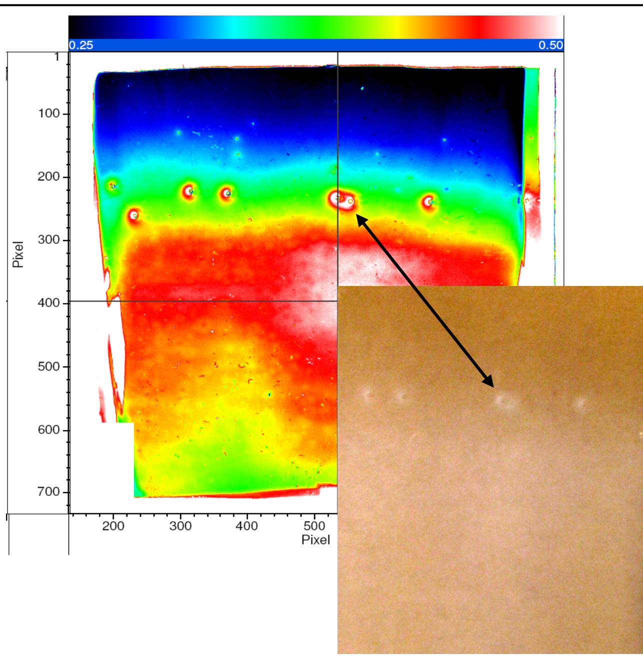
NREL Develops Technique to Measure Membrane Thickness and Defects in Polymer Electrode Membrane Fuel Cells

Project: Fuel Cell MEA Manufacturing R&D

NREL Team: Hydrogen Technologies & Systems Center and National Center for Photovoltaics

Accomplishment: NREL developed a technique to measure the two-dimensional thickness of polymer electrolyte membrane (PEM) fuel cell membranes for in-line quality control during manufacturing (first reported in May 2009). The technique is based on an NREL-developed instrument currently used in continuous manufacturing of photovoltaic cells. This 2-D measurement provides a significant advance over current techniques for in-line measurement because it enables simultaneous measurement of thickness and defect identification. As such, it provides the capability not only to represent the statistical variability of the material but also to view, in real time, actual defects. This enables much more rapid diagnosis of the source of the defects and ultimately reduces scrap, improves reliability, and enhances customer satisfaction.

NREL's work on in-line diagnostics for PEM membrane electrode assembly (MEA) components includes evaluation of existing devices supporting the papers, films, and foils industries and also relies on the advanced device-development capabilities at NREL. NREL has developed many devices and software capabilities related to photovoltaics manufacturing and is using this expertise to transition these already-successful devices to a new market—fuel cells. Many MEA component manufacturers, including 3M, Arkema, Ballard Materials Products, and BASF, have partnered with NREL on this project and are providing samples and guidance.



2-D image of a PEM fuel cell membrane sample measured with the NREL device (corresponding optical image in inset). The image shows bubble defects and a color shift in the sample. An area of approximately three inches by three inches is shown.

Context: The U.S. Department of Energy (DOE) supports the development of a domestic manufacturing base for fuel cell production and recognizes that, as the manufacturers scale their processes to meet market-demanded volumes for emerging markets, they will also need quality-control solutions that can be implemented in-process, during product fabrication. In-line diagnostics for some material properties have been developed already to support certain industries. However, these devices have not been validated universally for fuel cell materials, and many manufacturers desire expanded measurement capabilities or measurement of properties that are not supported by current in-line measurement devices.

Applicable DOE Technical Target: DOE's cost targets for fuel cell materials and systems are based on a projected manufacturing capacity of 500,000 fuel cell units per year. This volume for automotive fuel cells would require production of approximately 400 MEAs per minute.

Significance of Accomplishment: The technique, when validated in-line, will address DOE's manufacturing R&D milestones related to development and demonstration of sensors and diagnostics for in-line measurement of MEAs and components. The technique may also be useful for measurement of other critical properties of MEA components.

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