PRESS RELEASE

Quality assurance in fuel cell production

Bipolar plates are an essential component of fuel cells and are conventionally made of graphite. When it comes to efficiency and cost-effectiveness, metallic bipolar plates are far superior. However, the material forming process often engenders problems which impact quality. In the AKS-Bipolar research project, Fraunhofer IPM together with the University of Stuttgart and the industrial partners ThyssenKrupp and Chemische Werke Kluthe sets out to develop a digital-holographic sensor for comprehensive, in-line quality control of metallic bipolar plates.

High-performance fuel cell systems are an essential prerequisite for the generation of environmentally-friendly electrical energy from hydrogen. Fuel cell systems consist of numerous stacked membrane electrode assemblies (MEA) in which chemical energy is converted to electrical energy. Bipolar plates (BPP) are arranged between these units to supply the reaction gases and drain the resulting water. Depending on the type and size, modern fuel cell stacks contain between 300 and 600 BPP, typically measuring 400 by 200 millimeters.

Unlike graphite BPP, which are manufactured in a laborious machining process, metallic BPP are produced through cold forming. This is more cost-effective and also allows for a considerably higher rate of production. Another advantage of metallic BPP is that the material is less brittle and can be processed at lower thicknesses, which is a deciding factor for their use in, for example, automobiles. Metallic BPP can be manufactured out of sheet metal or metal foil with thicknesses of less than 0.1 mm. However, surface defects or deviations in dimensions frequently occur during the forming process, which complicate the assembly of the cell stack and compromise the functioning of the fuel cells. Until now, it has not been possible to reliably identify the majority of defects during production. This is why quality control is carried out downstream in costly and time-consuming spot tests.

3D sensors should recognize micro-defects in the forming process

The research partners in the AKS-Bipolar project (Active process control in the series production of high-precision embossed bipolar plates) are developing an inspection system for active process control and quality assurance which comprehensively examines the metallic BPP during the forming process with micrometer precision. In addition, simulation results are compared with the measurement data recorded by a digital-holographic 3D sensor. The objective is to create a comprehensive simulation tool chain which includes a digital twin of the forming process, on the basis of which recurring production problems can be numerically recorded and systematically resolved.

Editorial notes
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The inline-capable 3D sensor, developed at Fraunhofer IPM, generates high-precision measurement data in real time. The simulation results are provided by the team at the Institute for Metal Forming Technology (IFU) at the University of Stuttgart. The system will be produced as a demonstrator and tested in an industrial environment by the associated industrial partners, ThyssenKrupp System Engineering und Chemische Werke Kluthe. It aims to help identify critical process parameters in order to eliminate production defects in a targeted manner in the future. This will make it possible to reduce rejects, refine simulation methods and ultimately optimize the production process for metallic BPP.

Further information

The AKS-Bipolar project (Active process control in the series production of high-precision embossed bipolar plates) is funded by the German Research Foundation (DFG) and the Fraunhofer-Gesellschaft as part of the trilateral transfer projects.

Project partners

- Institute for Metal Forming Technology (IFU), University of Stuttgart
- Fraunhofer Institute for Physical Measurement Techniques IPM
- Thyssenkrupp System Engineering GmbH (application partner)
- Chemische Werke Kluthe GmbH (application partner)

Bipolar plates (BPP) perform important functions in fuel cell systems. State-of-the-art systems comprise up to 600 BPP. In the future, an in-line optical inspection system will check the quality of metallic BPP. (© Takashi Images/Shutterstock)

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