



LASER-BEAM WELDING OF BIPOLAR PLATES

Task

Fuel cells are the new hope for energy production in the future. They make it possible to convert the chemical energy stored in fuels (especially hydrogen and methanol) directly into electrical energy. They have a theoretical efficiency of up to 83 percent and only emit water vapor. The central element of the fuel cell is the bipolar plate, which usually consists of two formed thin-walled nickel sheets in its metallic variant. This project aims to weld these sheets by means of laser-beam welding. Doing this, however, poses particular challenges in terms of hermeticity, process time and reproducibility.

Method

In order to weld pure nickel sheets, especially with longer seams, both hermetically sealed and free of errors, a laser-compatible clamping device is needed, one that allows the sheets to be pressed over the entire seam length without gaps. The energy input into the component is precisely controlled by means of local power modulation using a single-mode fiber laser with high beam quality and a beam diameter of $< 30 \mu\text{m}$. An important design parameter is the degree of overlap, which results from the oscillation parameters in conjunction with the feed rate.

Results

By developing a complex fixture and adjusting the weld geometries in terms of arrangement and sequence, Fraunhofer is able to prevent process errors and reproducibly weld bipolar plates that are hermetically sealed. With adapted oscillation parameters (amplitude and frequency), high feed rates of up to 140 mm/s can be achieved. This results in a low energy input and a minimal heat distortion of the thin-walled nickel component. The mandatory use of argon as protective gas improves the welding pattern and allows oxidation-free surfaces.

Applications

The results of the process development can be used primarily to produce metallic bipolar plates, but can also be transferred to other applications such as the welding of sensor membranes in pressure measurement or the welding of rupture discs in battery cell production.

Contact

Vahid Nazery Goneghany
Telephone +49 241 8906-159
vahid.nazery@ilt.fraunhofer.de

Dr. Alexander Olowinsky
Telephone +49 241 8906-491
alexander.olowinsky@ilt.fraunhofer.de

1 Metallic bipolar plate with
hermetically sealed weld seams.

2 Cross-section of a weld.