

HIGHLY FLEXIBLE BIPOLAR PLATES FOR REDOX-FLOW-BATTERIES

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ISSUE

Up to now thermoplastic based bipolar plates are manufactured in a two-stage process by compounding and injection moulding or compounding and hot press moulding. Those bipolar plates are usually severely limited in size and thinness and can not combine conductivity and flexibility, as those two properties usually exclude each other by the influence of the filling grade.

APPROACH

By using a heated multi-roll rolling mill and a compound of graphite, carbon black and a thermoplastic elastomer, Fraunhofer UMSICHT has succeeded in manufacturing conductive and highly flexible bipolar plates in a continuous one-stage process. By adapting the roll size or welding of several sheets, the bipolar plates can be manufactured in any size up to several square meters and current thicknesses down to 0.4 mm.

MATERIAL PROPERTIES

The manufactured bipolar plates are gas-tight, chemical resistant, mechanical stable and allow for a subsequent reshaping. Exemplary tensile tests according DIN EN ISO 527-3 have shown an elastic modulus of 1100 N/mm² as well as a tensile strength of 7.4 N/mm² at a strain of 1.6% and filling grade of 80% graphite and carbon black. Depending on the carbon content, particle size and morphology the in-plane conductivity of the bipolar plates ranges from 250 S/m up to 5000 S/m and exceeds the through-plane conductivity consistently by a factor ranging from 10 to 100.

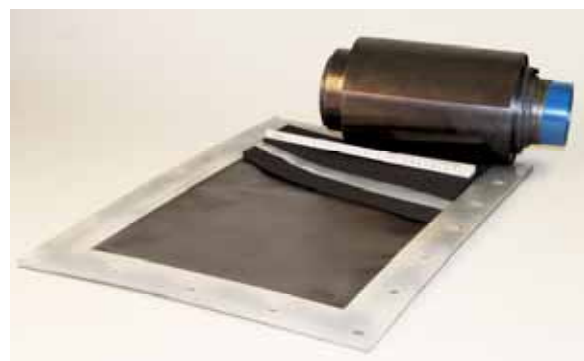
APPLICATION AND OUTLOOK

The bipolar plates enable the manufacturing of large seal-less redox-flow-stacks using plastic welding technologies to create a substance-to-substance bond between the frames, membranes and bipolar plates. The ongoing research includes the further reduction of the thickness of the bipolar plates down to 0.1 mm and the increase of the electrical conductivity as well as the examination of suitability for the use in low and high temperature PEM fuel cells.

RESULT



3.1 m²-sized bipolar plate welded with a plastic frame



2500 cm² redox-flow-cell & a coil of a continuous produced bipolar plate



Left: high flexibility of the bipolar plate, right: stack with 4000 cm² cells