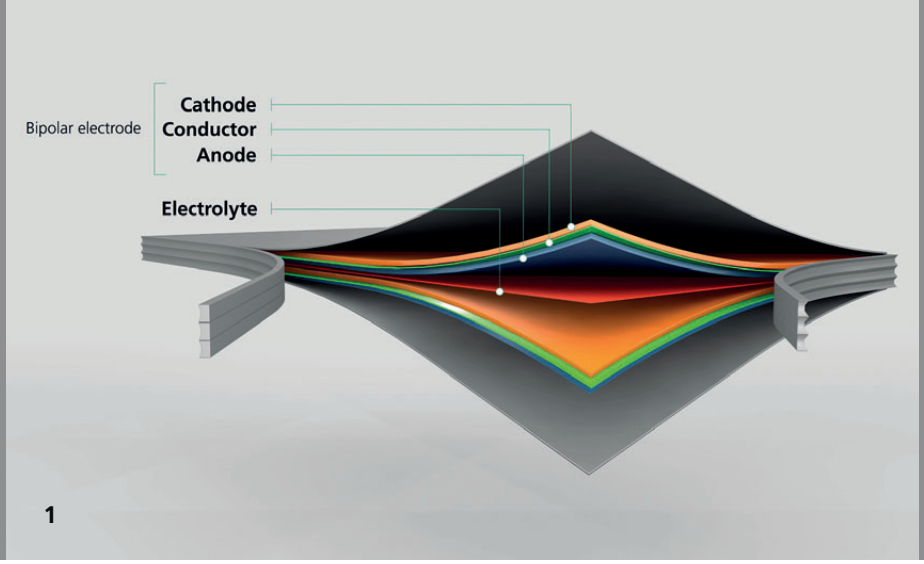

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EMBATT – BIPOLAR LITHIUM-ION BATTERY FOR SAFE DRIVING WITH GREAT RANGE

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The concept behind the EMBATT battery

In addition to a reduction in product costs for vehicle batteries, an increase in energy density and range is seen as a prerequisite for electric vehicles to reach broad market penetration. When it comes to the established lithium cell technology, this issue is addressed by introducing active materials with increased energy density, and through optimized cell and system packaging.

The EMBATT bipolar battery is based on a design principle already established for fuel cells and transferred to Li-ion batteries (DE 10 2014 210 803 A1, WO 2015/185723 A1). The basis of the new battery structure consists of stacked large-area electrodes with a bipolar layer structure. The cells of the EMBATT bipolar battery in a stacked construction are stacked in such a way that the conductor of the negative electrode of one cell functions as the contact of the positive electrode of the next cell. Two electrochemical cells connected in series thus share the same conductor – one side of the bipolar electrode serves as the anode in one cell and the other side as the cathode in the next cell. The larger and thicker the electrodes, the higher the battery's capacity. The stacked structure of the EMBATT battery yields a high system voltage and excellent performance parameters by reducing the internal resistance.

In recent years, Fraunhofer IKTS and its partners have primarily developed processes for the production of bipolar electrodes on a pilot scale, thus creating the prerequisites for scaling EMBATT up to a size of 20 x 30 cm². Today, these cell stacks are filled with liquid electrolytes and then tested.

Increased safety thanks to polymer electrolytes

In a next development step, the flammable, highly volatile liquid electrolyte is to be substituted by polymer electrolyte materials. Suitable candidates are currently being investigated with regard to their suitability and processability. Specific properties, such as conductivity and, above all, chemical and electrochemical stability against potential anode and cathode materials, are being considered. When mixed into composites, active materials and polymer electrolytes form the basis for the composite electrodes of the future.

At IKTS, bipolar electrodes have already been infiltrated with PEO (polyethylene oxide), and thus composite cathodes have already been successfully produced on a pilot scale. PEO is cost-efficient and easy to process, and is therefore being investigated as a polymer electrolyte.

During the tests conducted in the pilot plant, the polymer was heated up to the softening point of 60 °C and infiltrated into the electrode before drying out the solvent at a temperature of 80 °C. This was followed by a final validation where the electrochemical function of PEO-LITFSI-infiltrated layers was confirmed in cycle tests with lithium as counter electrode.

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1 *The EMBATT setup.*
2 *Infiltration of polyethylene oxide in bipolar electrodes on pilot scale.*

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