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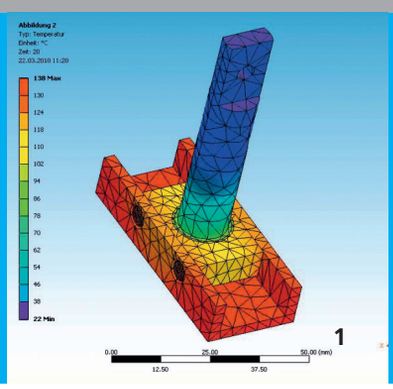

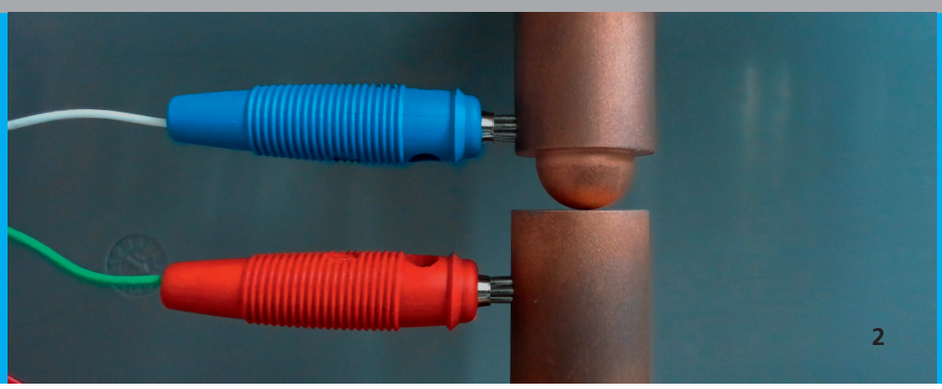

1 *Heat distribution inside the test specimen.*
2 *Example of a contact pair configuration.*

INVESTIGATION OF GALVANIC HIGH CURRENT CONTACTS

Outset

The percentage of electrically driven vehicles in road traffic is increasing steadily. One important prerequisite for making this type of vehicle drive more attractive is a fast recharging option for the vehicles' on-board energy storage units.

In order to keep charging times short, high charging power is needed, which means that high currents occur at contact points. Due to the physically inevitable contact resistance, there is also a massive voltage drop at contact points. The result of a voltage drop is a loss of useful energy: because the energy is converted to heat at the contact point, it is no longer available for the charging process. Instead, the components heat up, resulting in an increased thermal and mechanical wear or even a breakdown of the overall system.

Key Aspects

The Fraunhofer Institute for Transportation and Infrastructure Systems IVI offers the development of system solutions for the fast transmission of electric energy to vehicles. The major focus of the approach is on the comprehensive investigation of the contact system, starting with individual contacts and ending with the overall system. The work carried out focuses on:

- Design and construction of components and systems used in the transmission of energy during the fast charging processes of electrically driven vehicles,
- Taking measurements of high temporal resolution and analyses of dynamic behavior,
- Model-based design and optimization of system-relevant parameters,
- Investigations concerning the suitability of different contact materials, specific geometric shapes and different contact forces.

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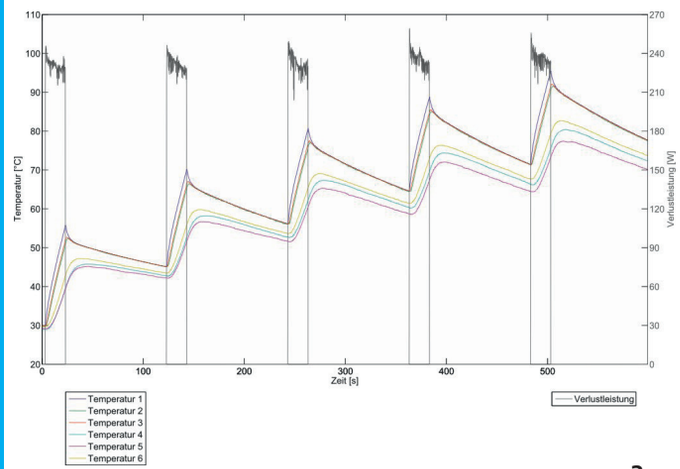

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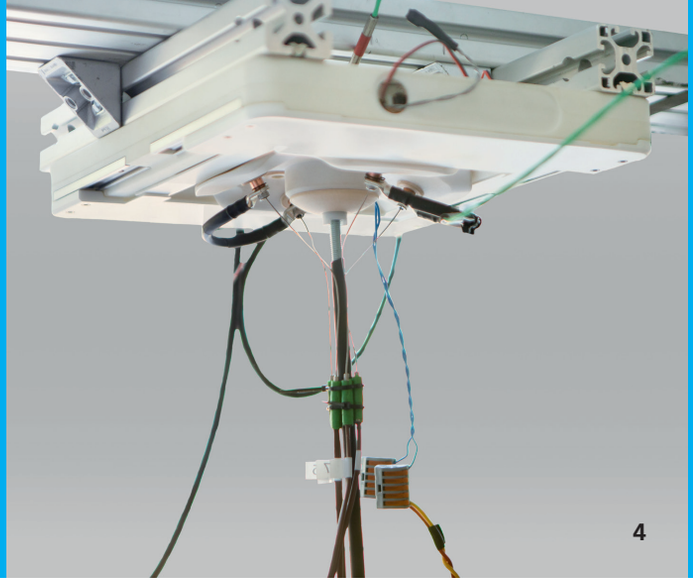

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Approach

One particular challenge to recording the heating processes during energy transmission is their highly dynamic progression. In order to make quantitative statements about the parameters exerting influence on the heating processes, special measurement equipment with high temporal resolution is needed. The multitude of possible influence factors, such as the electrical, mechanical and thermal characteristics of the contact pair, complicate the system's overall design and optimization.

Before a complete contact system can be integrated into any operator's existing infrastructure, a holistic assessment process is necessary, beginning with the individual contacts and ending with the integrated system. The starting point of this process is the choice of suitable contact materials and the specification of their appropriate geometrical shape, as well as their corresponding contact forces. These factors have a major influence on the thermal and mechanical behavior of the individual components.

Furthermore, it is possible to influence the electrical properties of components by the choice of surface structure and coating. These properties and their effects on each other must be considered when assembling the components of a complete system.

Technical Equipment

A test stand for the characterization of contact bodies and contact systems for high current energy transmission was developed and installed at the Fraunhofer IVI. Due to its extremely fast measuring data recording capacity, it is possible to study and automatically evaluate dynamic processes.

- Sampling rate of control and measurement signals: 400 Hz to 220 kHz,
- Contact resistances > 5 µΩ,
- Contact forces within a range of 5 to 500 N,
- Transmission of currents up to 3000 A.

For a better detection of the interdependencies between individual parameters and their influence on the overall system, all experimental studies are accompanied by model-based simulations of the contact partners' thermal and mechanical behavior. No complicated testing is needed for the further development and optimization of the components investigated. This approach results in major time and cost savings.

Range of Services

- Design, simulation, implementation and testing of system solutions for the fast transmission of electric energy to vehicles
- Characterization of contact pairs for the transmission of electricity
- Type detection of battery contacts
- Thermal analyses

Application Examples

- Development and testing of suitable contact and connection concepts for SuperCap cells, »Fraunhofer System Research for Electromobility – FSEM«, 2009-2011
- Development of a contact system prototype for the fast charging of electric vehicles, »Fraunhofer System Research for Electromobility – FSEM«, 2009-2011
- Characterization of electric resistances in welded metal joints, Fraunhofer IVI, Fraunhofer IWS, 2012
- Testing of the contacts used in an industrial solution for the fast charging of a public transport bus »SEB-EDDA-Bus«, 2014-2016
- Testing of the contacts used in a charging system for the fast charging of electric vehicles, »AULA«, 2016-2019
- Characterization of the electric resistances in welded metal joints, Volkswagen AG, 2020

References

https://s.fhg.de/PdT

3 *Development of power loss and temperature increase during five consecutive high current transmission processes.*

4 *Measurement setup.*