FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY ICT
FRAUNHOFER INSTITUTE FOR MANUFACTURING ENGINEERING AND AUTOMATION IPA

CONTACTS FOR ELECTRICALLY-CONDUCTIVE POLYMER COMPOSITES

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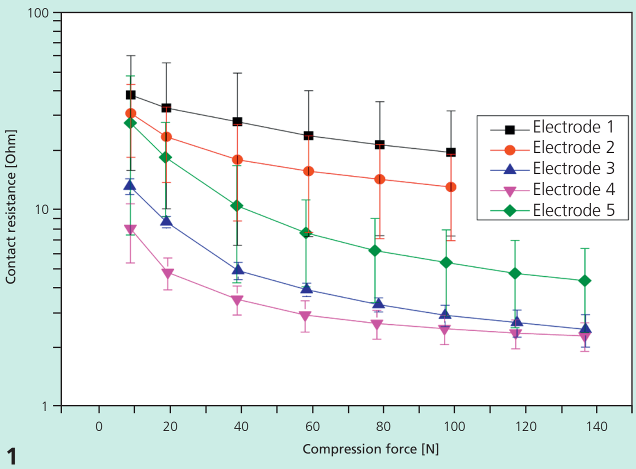
The increasing scarcity of energy resources and metals means that lightweight construction and metal substitutes are becoming increasingly important. For many applications, electrically-conductive polymer composites based on conductive carbon modifications are an ideal solution to the problem because of their low density. In recent years considerable progress has been made in the manufacturing and processing of electrically-conductive polymer composites. Such composites are suited principally as a substitute for copper wires at low power levels, for example in LEDs and the transmission of electrical signals, and in many cases can be integrated into systems more rationally than copper wires.

Problem

When using conventional connections (plug and socket), plastic-to-metal connections experience much less force than metal-to-metal ones. This means that the pollution layers on the metal cannot be removed, which has an adverse effect on the contact resistance. It is also generally harder to access conductive particle networks below the surface of the plastic, and the long time behavior of plastic-to-metal contacts differs considerably from that of metal-to-metal contacts.

To solve these problems, new concepts for plastic-to-metal contacts are being developed which meet the specific conditions in the plastics processing industry.



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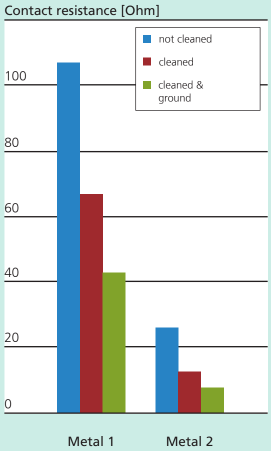

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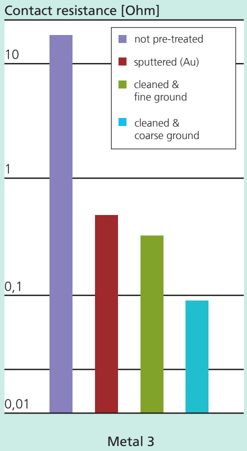

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Concepts

Fraunhofer IPA and Fraunhofer ICT are working together to develop solutions for the problem areas presented above. Amongst other things, the objective is to characterize the contact solutions obtained and to optimize them through new contact concepts.

We investigated the following two basic contact methods:

- Compression contacts, in which the two contact surfaces are pressed together at their interface by a design-induced normal force
- Fused connections, in which the molten plastic material is brought into contact with the metal surface and hardened onto it

Example of results

1 shows the contact resistance to the polymer composite in a compression contact as a function of the metal electrode material. The reduced standard deviations in electrodes 3 and 4 show that, beside the reduction of contact resistance, contacts may be made considerably more reliable by using a suitable material.

In the fused connections we considered two main options:

- Pressing heated metal pins into the thermoplastic composite
- Pressing fused strands of conductive plastic composites onto metal surfaces

When pressing in metal pins, the heated pins are pressed into a plate of the conductive composite. As shown in **2**, the contact resistance is considerably affected by the metal variant used. Pre-treating the metal surface also plays a decisive role.

When fused strands of conductive composite are applied onto a metal surface, a heated strand is pressed onto the metal via a template. Fig. 3 shows that the contact resistance varies significantly depending on the metal and pre-treatment method used. The correct pre-treatment of non-precious metals can achieve contact resistances which are comparable to those of precious metal surfaces.

Our offer

Both the electrical properties of composites and their contact resistance depend very much on the processing conditions used. For each application a complete system can be optimized in the light of basic findings on how the parameters concerned affect the different contact methods.

Our offers are:

- Analysis of the conductive polymers you are planning to use in production, to determine feasibility and cost-effectiveness
- Design of strategies for specific applications in terms of production methods and contacts
- Support in implementation in production

1 *Contact resistances of different electrode materials as a function of compression force on the electrode.*

2 *Contact resistance of metallic pins pressed into a conductive composite as a function of surface and treatment methods.*

3 *Contact resistance of strands pressed onto metal surfaces as a function of surface treatment.*