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1 *The demonstrator is a composition of molded plates made of electrically-conductive plastic, which are used for the power supply of two LEDs.*
2 *Demonstrator produced in a two-plastic injection molding process for the operation of a light-emitting diode without a series resistor.*

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ELECTRICALLY-CONDUCTIVE PLASTIC COMPOSITES

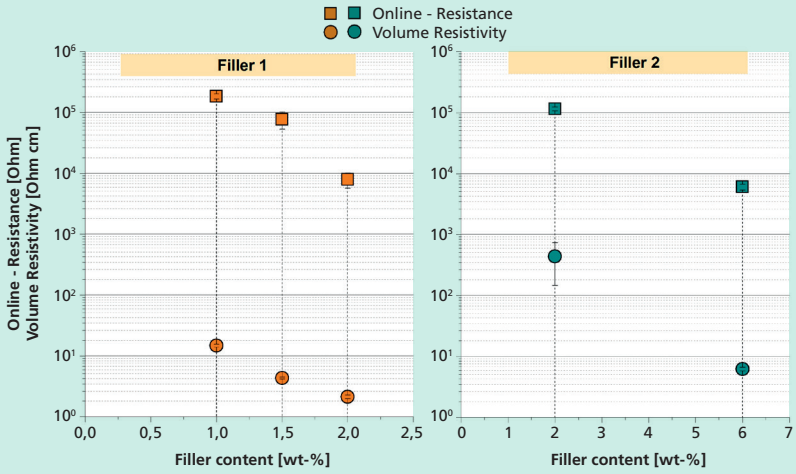
The advantage of electrically-conductive plastic composites is that they can be processed with conventional shaping methods, e.g. injection molding for thermoplastics or molding techniques for thermosets. In the finished component the desirable properties of the selected plastic combine with the additional functionality of electrical conductivity. Components combining these properties are suitable for electromagnetic shielding, for the transfer of electrical energy and electrical signals or as transmitters.

Formulation development

Depending on the application, experts select the appropriate thermoplastic or thermosetting matrices as well as suitable conductive fillers.

Generally, all commercially-available plastics are suitable as matrix material. Conductive fillers can be metals or carbon-based materials. The selection depends on the required conductivity and the planned application. For example, metals cannot be used in corrosive environments. Processability, and especially the melt viscosity of the composite, also play an important role.

Apart from traditional conductive fillers such as metal fibers or carbon black, researchers at the Fraunhofer ICT use carbon nanotubes (CNTs), structured CNTs and Graphene, either as dry fillers or as aqueous suspension. These enable electrically-conductive composites with a significantly lower filler concentration than, for example, is the case with carbon black. The flowability of the melt as well as the mechanical properties of the composite are consequently less affected than in cases where other conductive fillers are used.



Processing technology

The targeted properties of the finished component depend on it's composition as well as the complete processing chain, from the compounding of the material to the molding of the component. Specialists monitor the complete production process and optimize the material composition and manufacturing process regarding technological as well as economic aspects.

Quality assurance

A consistent product quality is of crucial importance for the success of a company. Researchers at the Fraunhofer ICT therefore develop solutions for the measurement of the electrical properties of the polymer melt during the process. These correlate with the electrical properties of the manufactured components. By this means, deviations from the specified values can be detected during the production process and eliminated by appropriate measures.

The above Diagrams show a comparison of the measured online resistance of the melt while compounding and the specific volume resistivity of pressed samples from the compounded material for two different conductive fillers in the same matrix.

Applications

Possible adjustments of the electrical conductivity allow a range of applications, from antistatic applications through to highly conductive composites (> 1000 s/m). The latter can be used as bipolar plates in power engineering or for the production of conductive pathways in the two-plastic injection molding process to replace traditional wiring.

For the application of electrically-conductive composites in products, as a rule electrical contacts need to be established between metallic junctions and the conductive composites. Solutions are being developed to ensure continuous operation.