Functional Polymer - Metal - Composite Material

Polymer-metal-composites combine the positive characteristics of both materials and provide the user with many possible new applications. The difference from other commercially available composite variations is the very high content of up to 50 Vol% of the metallic filler material.

Accordingly, this composite material combines the good chemical stability, low weight and easy processing of polymers with the excellent electric (up to $5 \times 10^6$ S/m) and thermal conductivity of metals. Despite the possible high degree of filler material content, the material can be processed with commercially available equipment from the plastics industry under almost always consistent conditions.

The principle

This material is produced in a special manufacturing process that will take the final application and the subsequent applied load into consideration right from the start. The varying proportions of every single material component can be individually adjusted, as well as the choice of the materials themselves. Matrix polymers can be chosen from a series of thermoplastic materials like e.g. Pa 6, Pa 6.6, Pa 12, PP, PPS, ABS etc. or from thermoplastic elastomers, as well. As an additive, solid or molten metallic materials can be compoundend into the plastic melt. Here, too, the choice of materials can be varied according to requirements.
Applications

The composite material can be processed by extrusion or injection moulding and, based on the choice of matrix polymer, by machining, too. It can be compacted by compression moulding and can be processed by rolling and calendering into thin layers of semi-finished product suitable for lamination. Possible applications for the material are e.g. functionalised assemblies that require the implementation of partial / local electric or thermal conductivity by integrative manufacturing processes like two-component injection moulding or co-extrusion. As full-surface application in cable sheathing or electronic housings, the composite material achieves a similar shielding effectiveness (80-90 dB at 300 kHz – 1,2 GHz) as metallic materials.

Composites with sensorial properties

Aside from the applications as electrically or thermally conductive plastic, the composite material is suited equally well for the use as intrinsic sensorial material. Depending on the choice of the matrix polymer and the degree of filler content, the composite can be adapted to detect tensile or compressive stress and can therefore be used for e.g. Structural Health Monitoring. Especially the use of soft flexible elastomers as matrix material offers a wide variety of possible applications in the area of sensorial functional integration.

Load tests in test equipment show a high reversibility of the signal amplitude and a very good signal enhancement of the composite material in a wide range of tested functions.

Our offer

The polymer-metal-composite possesses a large potential in the area of integrative functionalisation of parts and assemblies, which to some extent, is due to its efficient and economic processability.

Fraunhofer IFAM offers you the following services:

- Individually tailored composite formulation for special applications
- Material samples and optimisation up to the start of series production
- Material testing and characterisation of physical, chemical and mechanical properties of customized composite
- Analysis of reliability, aging and climatic behaviour of the composite
- Testing of manufacturing processes, like injection moulding, extrusion, rolling etc.
- Market analysis and feasibility studies for functional composites
- Process integration, economic evaluation and know-how transfer

3 Soft elastic composite material, flexible like rubber and conductive like metal.
4 Injection-moulded housing from plastic-metal-composite with electromagnetic shielding properties.