One advantage of functionalized thermoplastic polymers, such as electrically conductive polymer composites, is that they can be processed using additive manufacturing as well as conventional shaping methods (e.g., injection molding). This also allows the complementary combination of the processes as required, in order to exploit the advantages of both conventional and additive manufacturing. In the finished component, the desirable properties of the selected base plastic are thus combined with additional functionality, while additive production enables increased component complexity if required, individualization potential and the possibility of producing even small series economically. Electrically conductive components, for example, are suitable for electromagnetic shielding, for transmitting electrical energy or electrical signals and, in particular, for application as sensors or transmitters.

**Formulation development**

Experts select thermoplastic matrices and suitable functional fillers according to the application. Generally, any commercially available plastic can be used as a matrix material. Metals or carbon-based materials can be used as fillers, for example in electrically conductive composites. The selection depends on the required conductivity and the specific application: for example, metals cannot be used in a corrosive environment. Processability, and especially the melt viscosity of the composite, also play an important role.
Besides traditional fillers for functionalization, Fraunhofer ICT can also apply nanomaterials. For electrically conductive composites, for example, scientists at Fraunhofer ICT also use carbon nanotubes (CNTs). These enable electrically conductive composites with considerably lower filler concentrations than can be achieved with metal fibers or conductive carbon black. As a result, the viscosity of the melt, and the mechanical properties of the composite compared to the matrix material, are less strongly affected.

Technical equipment available for formulation development ranges from various small-scale mixers, kneaders and extruders through to pilot plant compounding lines in which the composite is supplied as granules. A filament extrusion line for the production of filaments with diameters of 1.75 mm and 2.85 mm is also available.

**Process development**

The target properties of the finished component depend on the composition of the composite as well as the complete processing chain, from the compounding of the material to the molding of the component. Our specialists monitor the entire manufacturing process and optimize technological and economic aspects of both the material composition and the production process.

The equipment available for process development in additive manufacturing includes the extrusion-based additive manufacturing processes ARBURG plastic freeforming (APF) with a 2-component freeformer and fused filament fabrication (FFF). In addition, accompanying technologies such as plasma processes for the pre-treatment of printable substrates, or microwave processes for the post-treatment of additively manufactured components, as well as the accompanying characterization of materials and components, are provided by the test laboratory.

**Our offer**

We offer our customers services ranging from basic investigations and feasibility studies through to process engineering implementation.

- Feasibility studies
- Benchmark testing (APF, FFF, injection molding)
- Formulation development (filaments, granules)
- Determination of suitable processing parameters
- Consultancy in process and component design
- Characterization of materials and components