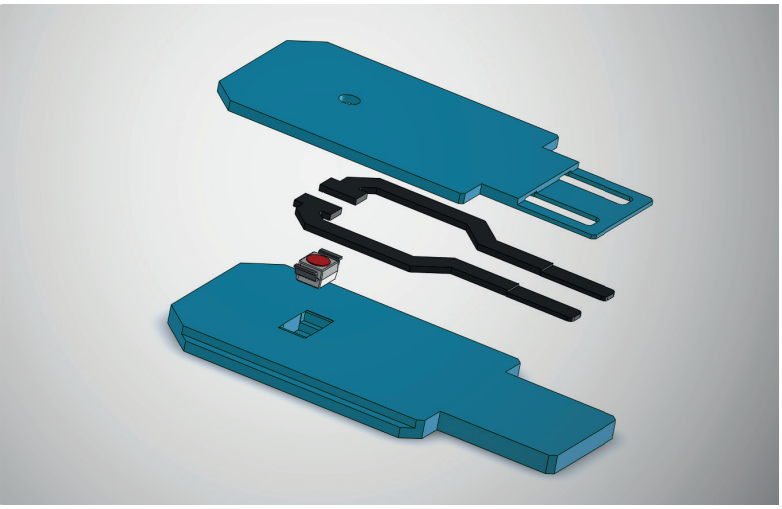
Fraunhofer ICT

Additive manufacturing

Functionalized thermoplastic polymers for additive manufacturing

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.

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.



Exploded-view drawing of the demonstrator "light stick": The lower casing component, the integrated light-emitting diode, conductive pathways produced in 2-component printing and the upper casing.

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 pellets. A filament extrusion line for the production of filaments with diameters of 1.75 mm and 2.85 mm is also available.

Process development

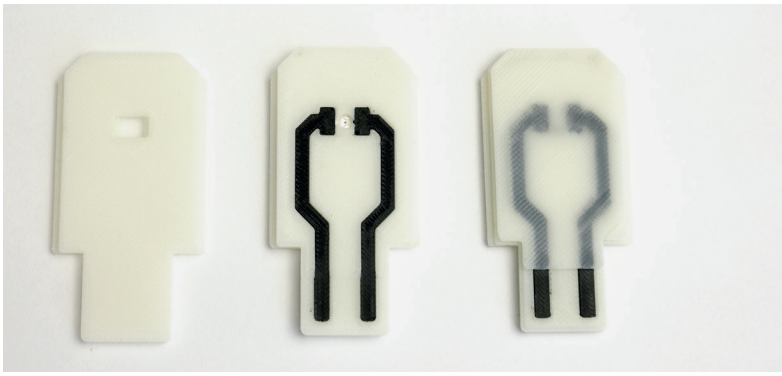
The target properties of the finished component depend on the composition of the composite as well as the complete processing chain, from the compounding of the material to the molding of the component. Our specialists monitor the entire manufacturing process and optimize technological and economic aspects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

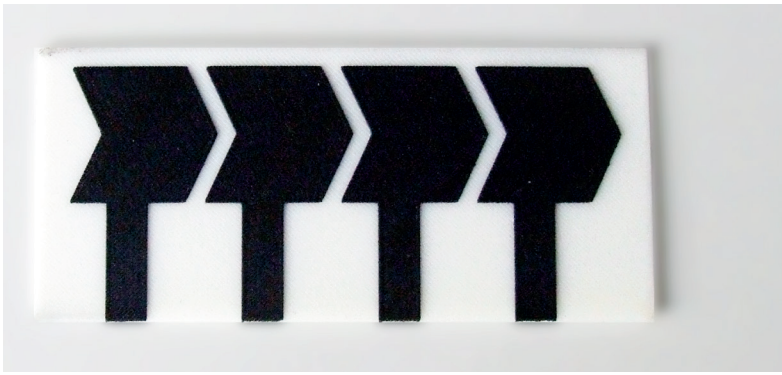
The equipment available for process development in additive manufacturing includes the extrusion-based additive manufacturing processes ARBURG plastic freeforming (APF) with a 2-component freeformer and fused filament fabrication (FFF). In addition, accompanying technologies such as plasma processes 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 Fraunhofer ICT 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





Top:
Demonstrator "light stick" in three consecutive manufacturing steps.

Above:
Demonstrator manufactured with 2-component ARBURG plastic freeforming (APF) for use as a proximity sensor or slide controller.

Contact

Dr. Christof Hübner | Functional Nanocomposites
Phone +49 721 4640-458
christof.huebner@ict.fraunhofer.de

Dr. Kevin Moser
Phone +49 721 4640-533
kevin.moser@ict.fraunhofer.de

Fraunhofer Institute for Chemical Technology ICT
Joseph-von-Fraunhofer-Strasse 7
76327 Pfinztal (Germany)

www.ict.fraunhofer.de