

## WE OFFER YOU

- Material development
- Additive manufacturing  
(FFF process, 3D or 4D printing)
- Materials with thermoresponsive properties (shape memory polymers)
- Multifunctional polymer materials
- Components with C-fiber reinforcement
- Characterization
- Quality control
- Consulting

### 4D PRINTING

- Shape memory polymers
- Filigree structures
- Adjustment of specific property profiles

### 3D PRINTING

- Shape memory polymers
- Filigree structures
- Multi-material printing

### CONTACT

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# The fascination of shape memory

## Programmable and programmed polymers manufactured by 3D printing

# SHAPE MEMORY POLYMERS


Shape memory polymers are programmable materials, that have considerable potential for the development of new applications. The fact that they can be programmed after thermomechanical treatment and are capable of thermoreversibly changing their shape, makes them particularly attractive. Additive manufacturing offers the possibility of producing demonstrators for a wide range of applications in a short period of time.

## Application examples:

- Robotics: autonomous systems that do not require external control and regulation technology
- Innovative positioning systems
- Self-deploying or shrinkable structures
- Objects with “morphing” surfaces


## INDUSTRIES


We see our solutions as cross-sectional technology that can offer added value beyond the boundaries of individual sectors.


 Automotive industry

 Agriculture

 Mechanical engineering


 Medical technology

 Polymer manufacturing industry


 Robotics

 Jewelry industry

 Security industry

 Toy industry

 Sports industry

 and many more



### Virtual component design

- Creation of 3D models (CAD)
- Design of components for additive manufacturing
- Design of filigree structures
- Definition of print paths for controlled layer build-up
- Lightweight structures



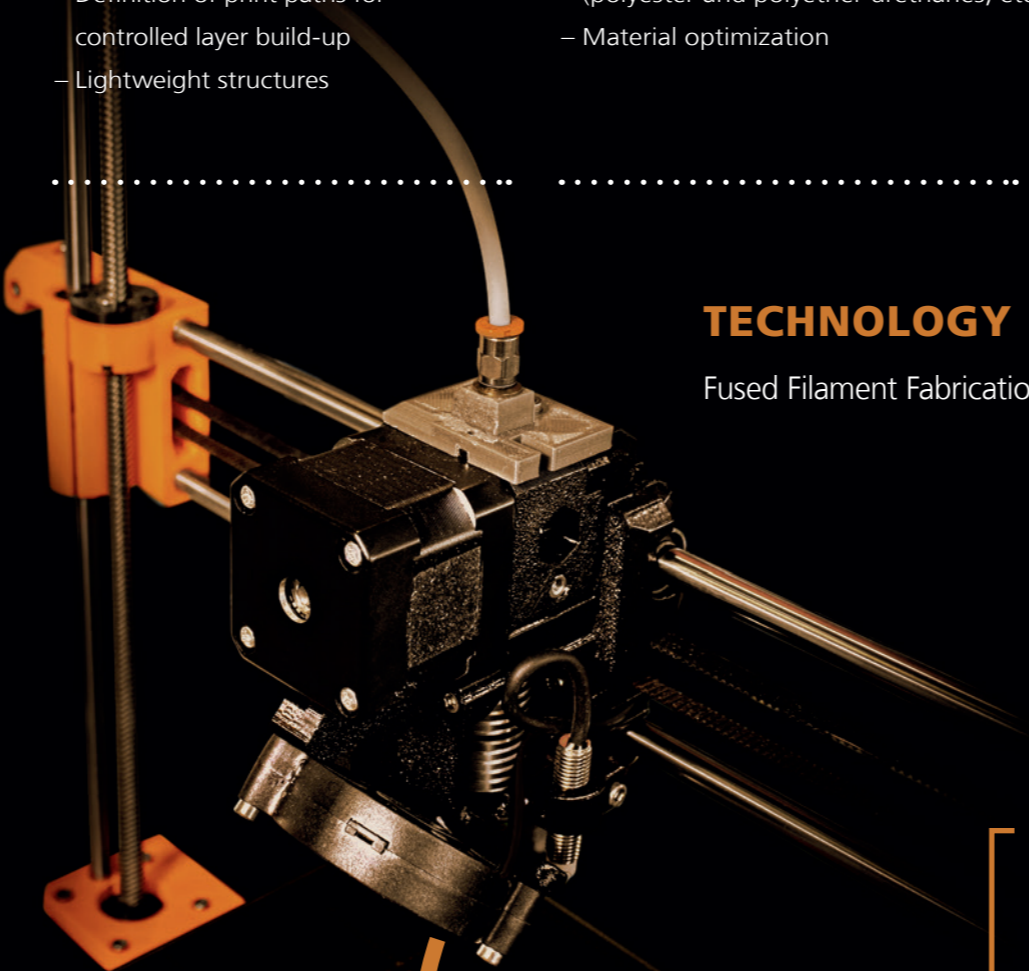
### Polymer synthesis

- Use of bio-based monomers
- Shape memory polymers
- Polyesters
- Thermoplastic polyurethanes (polyester and polyether urethanes, etc.)
- Material optimization



### Polymer processing

- Extrusion: Production of 3D-printable filaments, granules, powders
- Compounding: Addition of additives, waxes, magnetic particles, fillers, carbon fibers, etc.



## TECHNOLOGY

Fused Filament Fabrication (FFF)

### Multi-material printing

- TPU, PLA, PETG, PA, ABS
- Multilayer systems



3D PRINTING

### (*ex-situ*) Programming

- Thermomechanical treatment
- Adjustment of shape memory and stress memory effects
- Thermoreversible shape changes
- Quantification of the effects
- Investigations on the durability of the effects
- Parameter studies



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### End-of-Life Cycle studies

- Reuse
- Reprogramming
- Recyclability

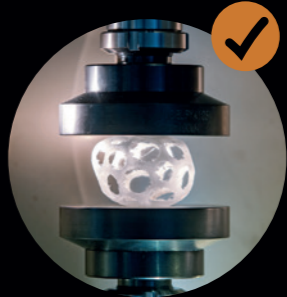


### Optimization

- Controlled strand deposition
- Slicer error correction
- Application-oriented property adjustments
- Post-processing of print objects

### Characterization

- Chemical | physical
- Thermomechanical
- Shape memory properties
- Durability
- Quality control



## 4D PRINTING

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### (*in-situ*) Programming

- Programming of the shape memory polymers during printing
- Complex shapes can be realized
- “Mechanical strength” / direction of movement can be influenced