SNAPS

Applied MedTech technologies

Fused Deposition Modeling (FDM)

Fused Deposition Modelling or Fused Filament Fabrication is an extrusion process in which chemically or physically prepared solid starting materials are melted from their solid phase and processed. Normally, these are first found as a wire or tablet, which are then melted in one or more heated extrusion dies.

So the production is done by feeding a filament into the printer and passing it through the printer gland into the extruder button. In the process, the printer gland is heated to the desired temperature. When the motor now pushes the filament through the heated nozzle, it melts. The printer moves based on the coordinates entered, depositing the material onto the build plate. The solidification then occurs during the cooling process, in which solvents are vaporised or chemical reactions are induced. At the same time, this phase ensures the cohesion of the individual materials used. As soon as a layer is finished, the procedure starts again from the beginning until the object has taken on the desired final shape.

One advantage of the process is that almost all materials can be used for processing. However, materials with low melting temperatures are preferably used due to their better processing properties. These include, for example, polyactides, polycarbonates, acrylonitrile-butadiene-styrene, polyphenylsulphone and waxes.

A strong bond between the heated materials and the already cooled components can only be created if the material is pressed on with the help of the gland. However, this requires that the gland axis always lies in the z-direction and results in ellipses approximately 0.5 mm thick as the final shape. If components with overhangs are to be produced with this process, additional support structures must be used. In modern, new machines, these are often made of water-soluble waxes or materials foreign to the component with even lower melting temperatures and processed using a second nozzle. In this way, subsequent removal can be carried out in a time-saving and cost-effective manner by washing out or heat treatment. The finished parts produced essentially have the material properties of the starting material.

Innovative approaches

- **Category:**
  Material extrusion
- **Rationale:**
  Layer-by-layer application of molten materials
- **Areas of application:**
  Concept models

  lost models for the melting-out and injection moulding process (e.g. for prostheses)

  Parts for fit, form and function control for subsequent production
- **Advantages:**
  Fast & inexpensive

  Non-hazardous processes Freedom of design

  Small machine dimensions

  Manufacture of compact workpieces Demand-oriented

  production

Other 3D printing processes besides material extrusion are:

- Vat polymerisation, e.g. stereolitography process (SLA)
- Powder bed fusion processes e.g. selective laser sintering (SLS)
- Material Jetting e.g. Drop-on-Demand (DOD)
- Binder Jetting e.g. Sand Binder Jetting
- Direct Energy Deposition e.g. Electron Beam Additive Manufacturing (EBAM)
- Micro 3D printing e.g. micro stereolitography (μSLA)
- Layer lamination e.g. ultrasonic consolidation