TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
The University of Resources. Since 1765.

ADDITIVE MANUFACTURING USING BIOBASED MATERIALS

TU Bergakademie Freiberg | Institute for Machine Elements, Design and Manufacturing |
Chair of Additive Manufacturing | Prof. Dr.-Ing. Henning Zeidler |
Agricolastr. 1, DE-09599 Freiberg | Phone: +49 3731 39-3066 | henning.zeidler@imkf.tu-freiberg.de

imkf Institute for Machine Elements, Design and Manufacturing

Additive Manufacturing using biobased materials

Prof. Dr.-Ing. Henning Zeidler
Dr. rer. nat. Falko Böttger-Hiller
Dr.-Ing. Gunther Glowa
Dr. rer. nat. Wolfgang Meyer

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Chemnitz, 13.06.2017

Gründungsmitglied
Sächsische Industrieforschungsgemeinschaft e.V.
Deutsche Industrieforschungsgemeinschaft Konrad Zuse e.V.

BECKMANN-INSTITUT für Technologieentwicklung e.V.

- founded in 1998 as an independent and non profit research center

Main focus of work

- Industrial and non profit/fundamental research projects
- Cooperation in bi- and multilateral projects
- Technology and knowledge transfer to industry
- Planning and realisation of scientific meetings, trainings, workshops and presentations to foster exchange of technical know-how

Services

- Manufacturing of models using additive manufacturing methods: Mask-photolithography (MPL), 3D-Printing, Selective Laser Sintering (SLS), Stereolithography (STL)
- Casting Technologies
- Plasmaelectrolytic polishing (design and development of systems, adaptation of electrolytes to materials, R&D)

Where we are

Chemnitz and ore mountains region

Orientation

What we do: Beckmann-Institute [BTE]

Service and R&D along the production process chain

Original demand for Rapid Prototyping and post-processing

3D Data processing
- 3D-CAD / point clouds
- CT und MRT data-conversion

Additive Manu-facturing processes
- Materialis
- Parameters
- Process chains
- MPL
- 3D-Printing
- SLA

Casting techno-logies
- Methods
- Materials
- Direct burn out mould parts

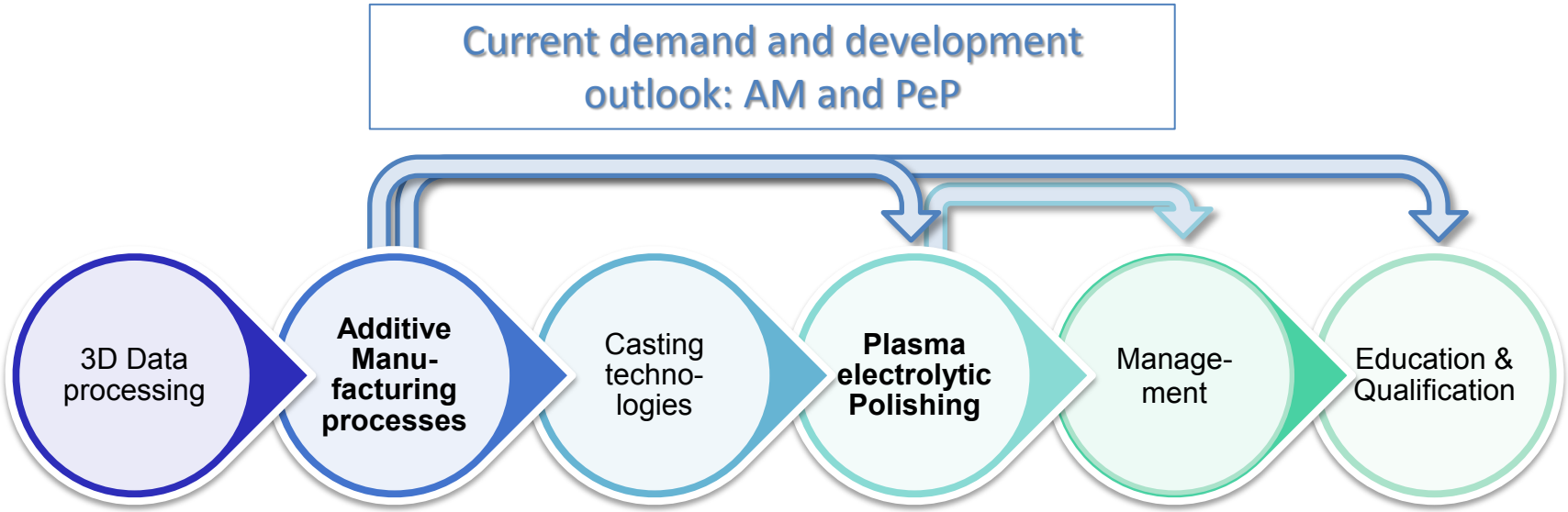
Plasma electrolytic Polishing
- Method
- Parameters
- Electrolytes
- Machines

Manage-ment
- Project management
- Technology transfer

Education & Qualification
- Courses
- Qualification

What we do: Beckmann-Institute [BTE]

Service and R&D along the production process chain



- 3D-CAD / point clouds
- CT und MRT data-conversion

- Materialis
- Parameters
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- 3D-Printing
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- Methods
- Materials
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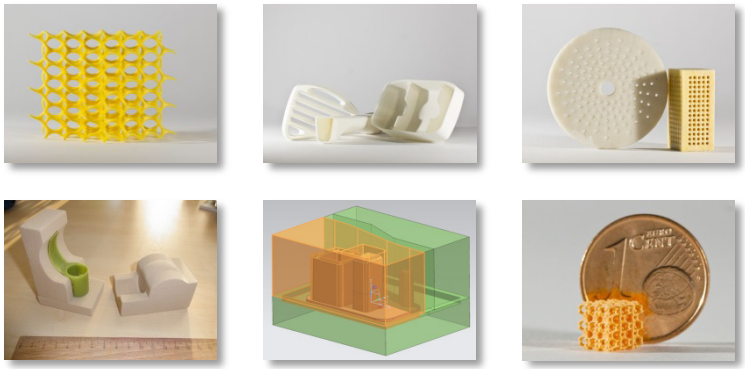
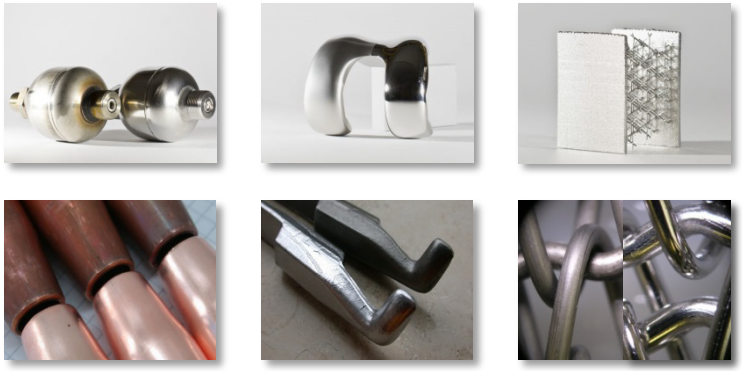
- Project management
- Technology transfer

- Courses
- Qualification

Main areas: AM and PeP

Additive Manufacturing		Plasma electrolytic Polishing
Functional **parts**	**Goal**	Functional **Surfaces**
[MPL]: Photo**polymer**s [3DP]: Powder (**Ceramics**, **renewable materials**)	**Materials**	**Metals** (Steels, Copper, CoCr, Nickel base alloys, Platinum, *Aluminium, Titanium*)
Material, application and process optimisation	**Development**	Process energy source, electrolyte, industrial machine tool



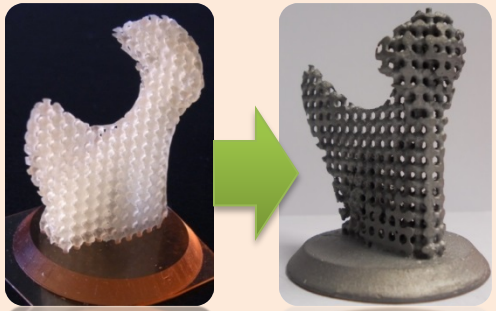
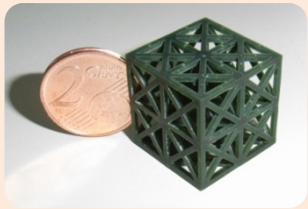
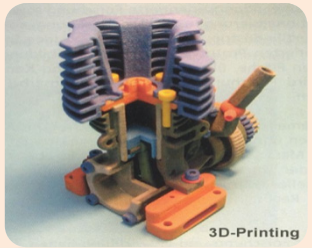


Additive manufacturing

- Production of prototypes using MPL (Mask Photoltihography, envisionTEC machine)
- Creation of display models using 3D-printing (zCorp)
- Execution of projects and tasks in AM material research (3dP and MPL)
    - Ceramic materials
    - Photopolymers
- Selective Laser Sintering (SLS) and Stereolithography (STL) in cooperation
- Consulting on AM topics

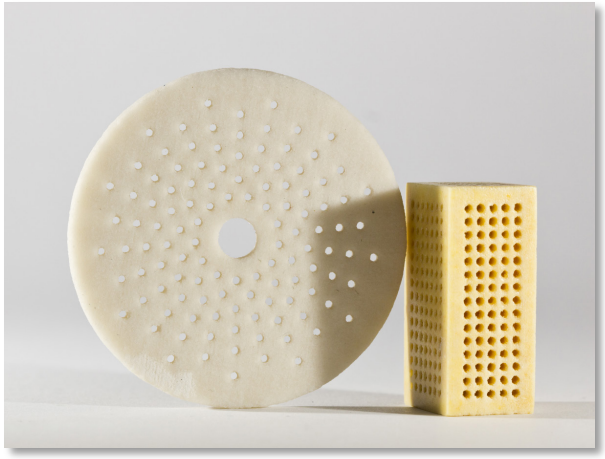
Additive manufacturing

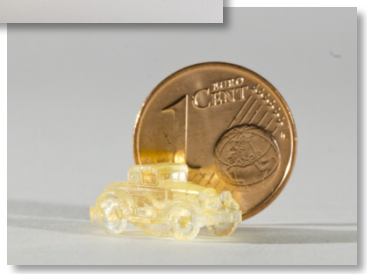
Additive Manufacturing / Casting process chain examples

3d printed hip model based on medical computer tomography **(CT) data**	**Titanium investment cast part using** Mask Photolithography (MPL) model with **thermal desintegrating material**	**Micro part** using **MPL** (shown with 2-Cent coin)	**3d printing** in colour for design and qualification
			

Additive manufacturing topics

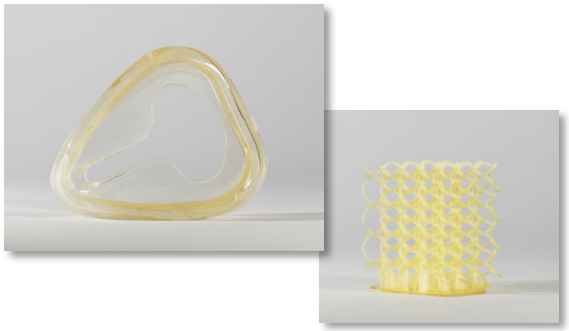
- Novel use cases for AM processes and parts
  - Medical applications (e.g. bioresorbable material, materials with integrated functionality)
  - Biodegradable parts (e.g. adapted packaging)
  - Technical post-processes (e.g. direct burn-out parts for model trees in investment casting)
- Adaption of AM processes
  - Binder<->Powder system optimisation for new materials (e.g. plant-based)
  - Software adaption (e.g. CAD/CAX plugin, CT/MRT data conversion, point clouds)





Additive manufacturing examples

- Flexible material AM for patient-specific parts
  - Design according to CT/MRT data
  - Patches: microstructured surfaces for controlled wound secrete and/or druq delivery
  - Adapted oxygen mask: elastic material for optimal wearing characteristics
- Use of Miscanthus plant for 3DP of biodegradable packaging
  - Thermally and mechanically stable packages
  - Adapted shape based on part CAD data
  - Safe transport for delicate parts of low batch size



Additive manufacturing directions

- High-throughput AM
  - 3DP and/or FDM
  - 3DP: Industrial scale inkjet printhead
  - FDM: Adapted nozzle shape based on part CAD data; 5-axis machine; extrusion head; ‘build on top’

- New materials for AM
  - Natural materials
  - Biomaterials

Miscanthus

Miscanthus

Miscanthus harvest

Powder

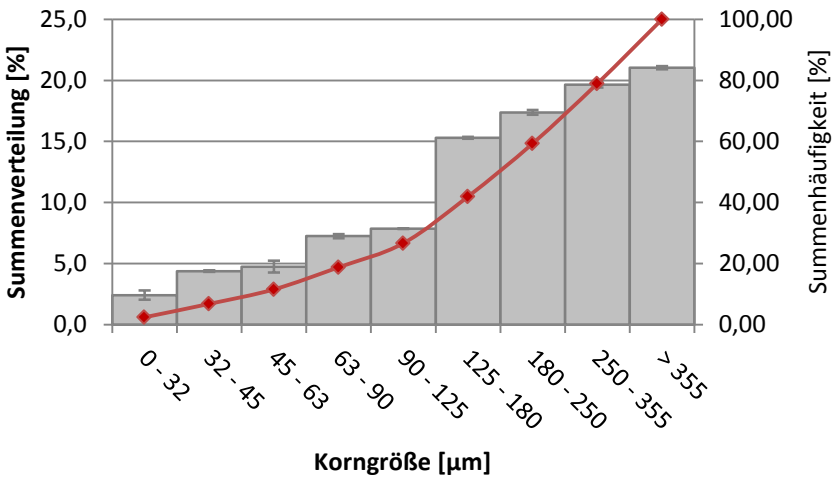
- 3D-Printing requires powder based material
- Optimum particle size distribution required
- Powder mixture to be generated using sieving

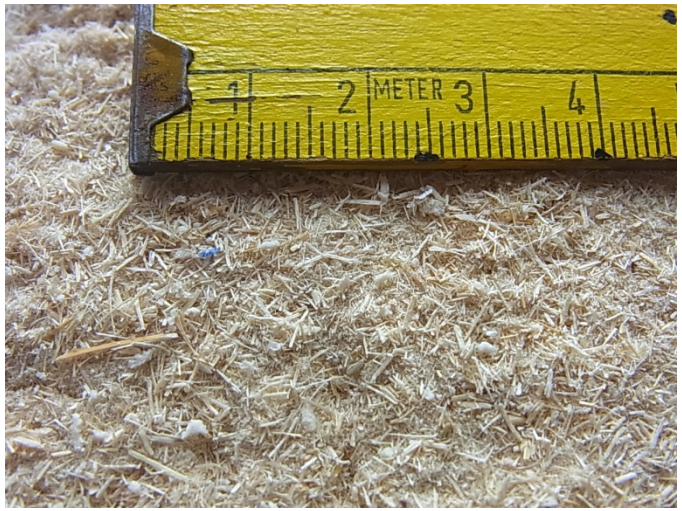
Radial mill
[Fa. Gießereitechnik Kühn]

Ultrazentrifugal mill und Siebving tower
[BTE e. V.]

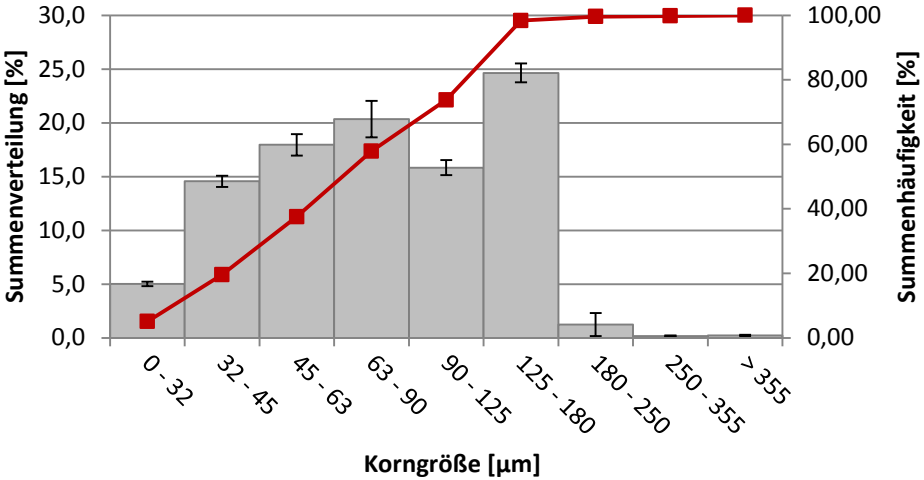
Powder

Original Miscanthus





Miscanthus < 180µm + PVA



Binder

- Miscanthus does not react to liquid binders
- Use of powder binders
- Activation using aquaeous solution

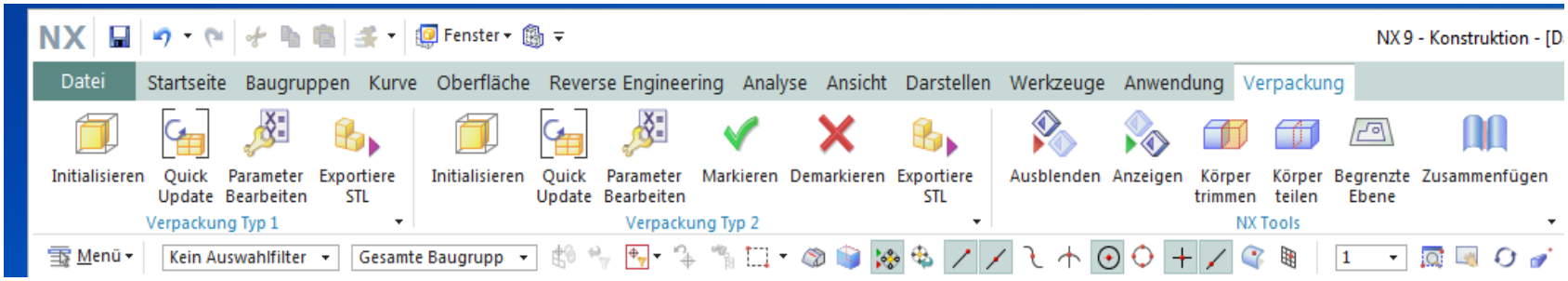
40 w% Ligninsulfonat

9 w.% Polyvinylalcohol

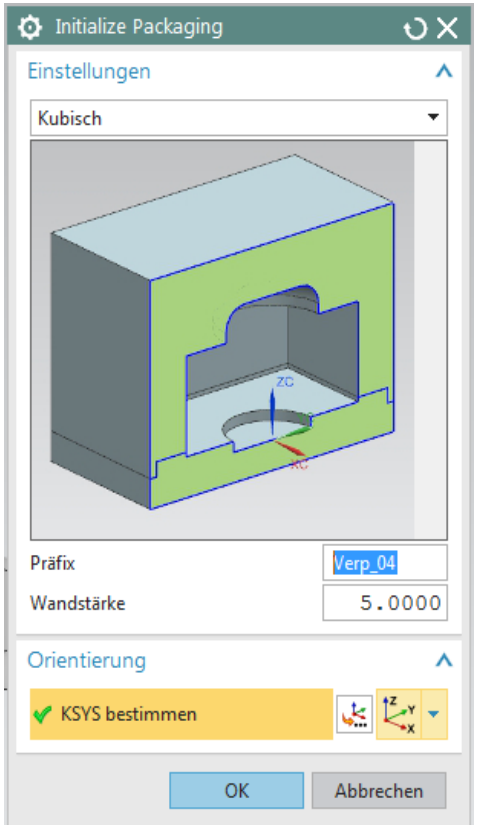
6 w.% na waterglass

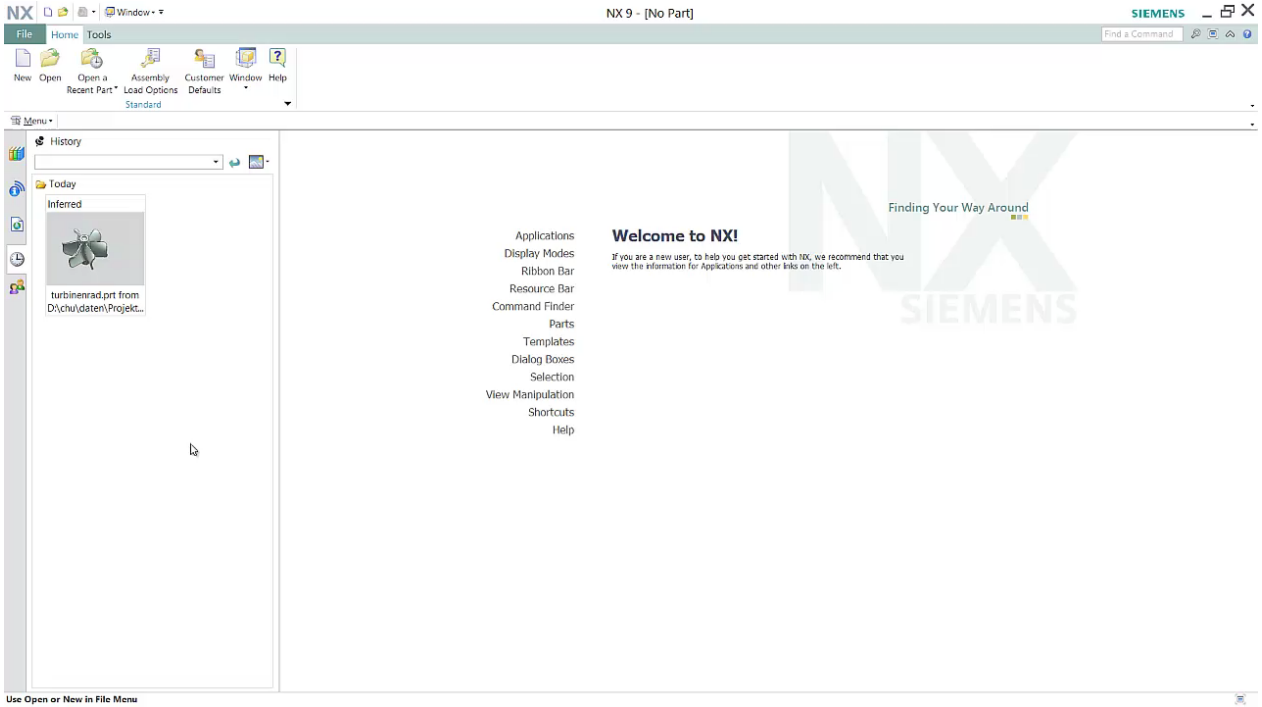
Software tool packaging assistant

- Programmed for NX9
- Package is created based on part geometry
- Simple use
- STL-data export



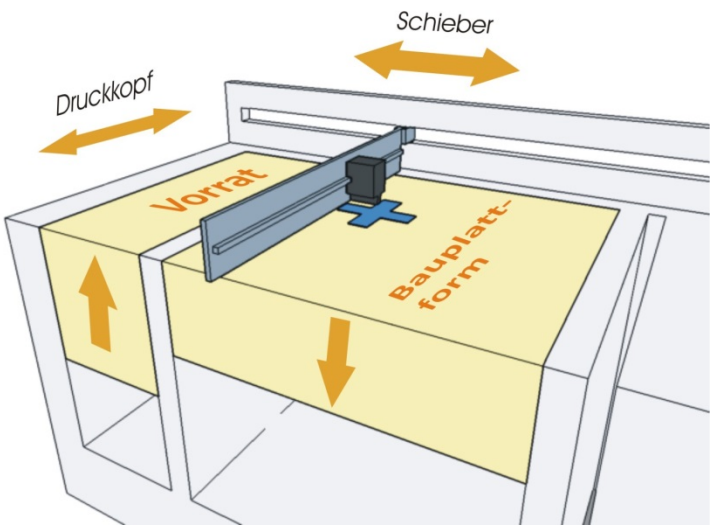
Packaging software



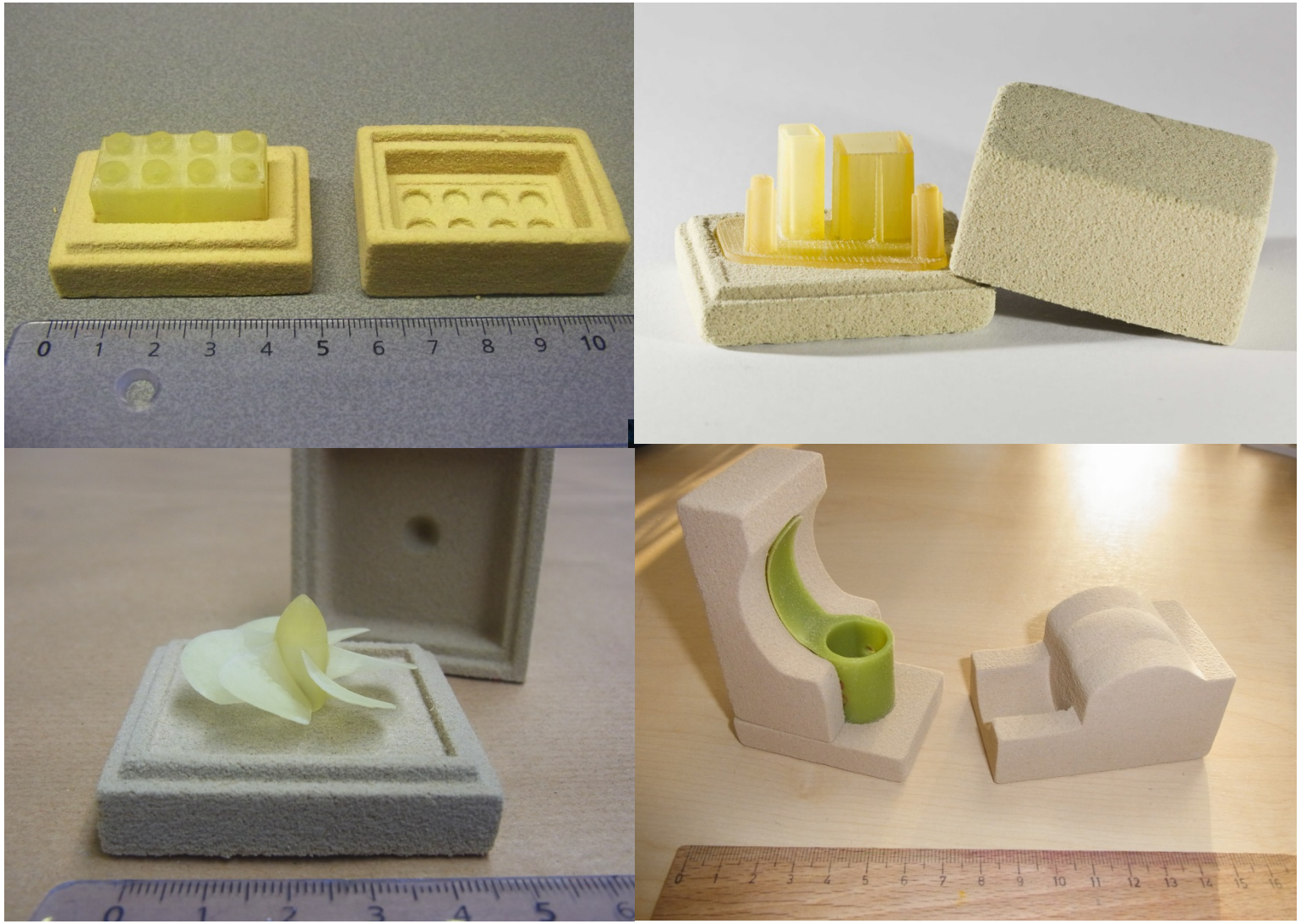


3D Printing

3DP of Miscanthus for adapted biodegradable packaging

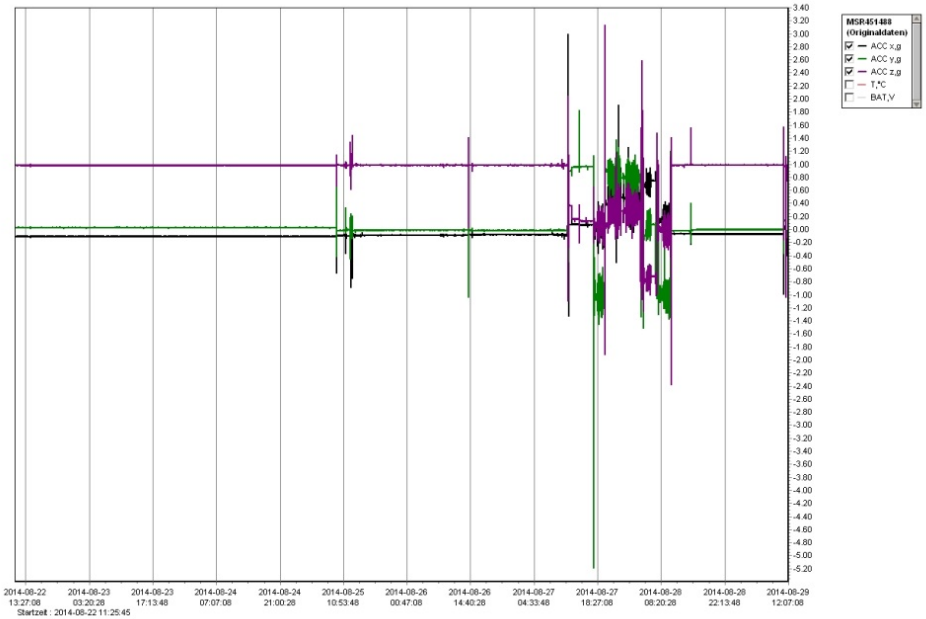


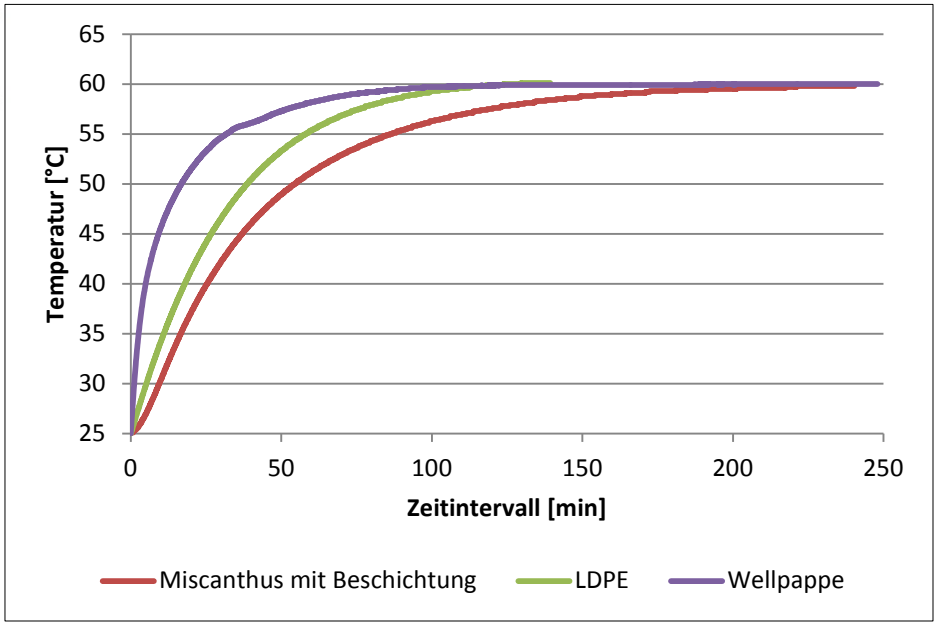
Packages



Assessment

- Forces and temperature have been logged during shipment





Aufzeichnung des Datenloggers während des Transportes [IDH e. V.]

Summary

- Just-in-time package manufacturing
- Individual manufacturing of packaging solutions for small batch and prototype parts
- Good damping properties
- Good insulation against temperature changes
- biodegradable Miscanthus-material
- Good availability of material
- Cost-efficient production

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International / cooperation

- DE-NZ collaborative projects (4 initiated and running)
- FRIENZ, scientific/technical collaboration, catalyst fund

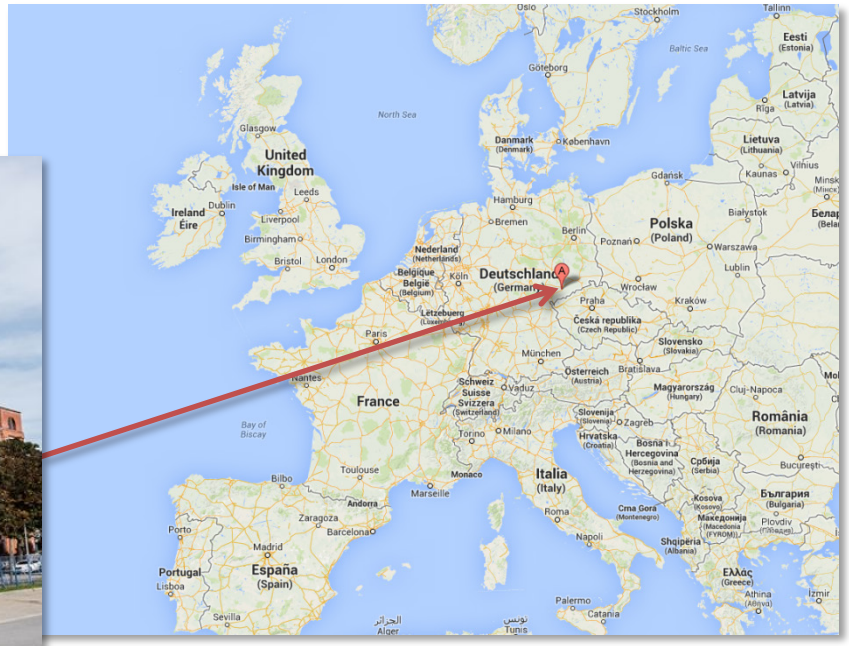
Contact

BECKMANN-INSTITUT für Technologieentwicklung e. V.

Annaberger Str. 73
09111 Chemnitz
Germany

www.beckmann-institut.de

Eml: info@beckmann-institut.de
Tel: +49 (0) 371 2397 0820
Fax: +49 (0) 371 2397 0825



Prof. Dr.-Ing. Henning Zeidler
zeidler@beckmann-institut.de