

Institute for Machine Tools and Industrial Management (*iwb*) Additive Manufacturing

Technical University Munich

Johannes Glasschröder

Locations of *iwb*

Technical University Munich

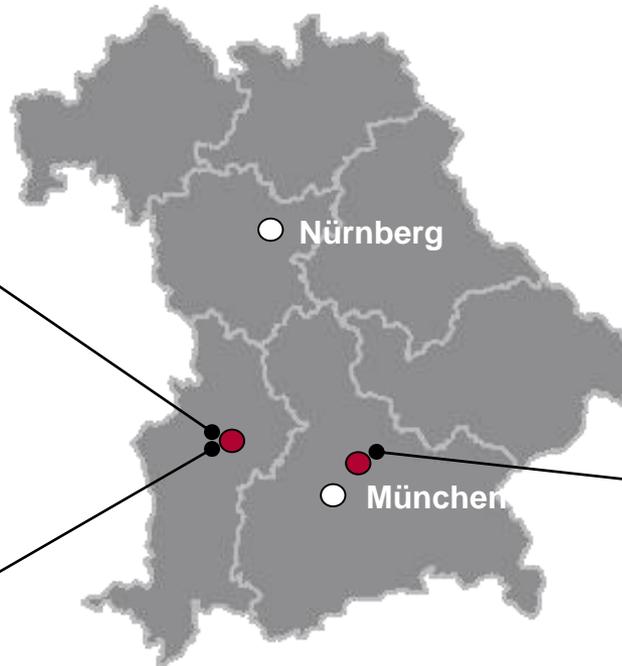


iwb Applications Center Augsburg

Applied research and transfer of technology



Resource efficient Mechatronic Processing Machines

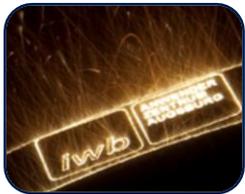


iwb Garching

Research and teaching in production engineering

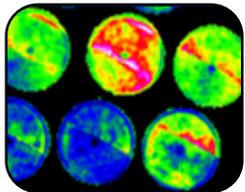
Additive Manufacturing

Research fields



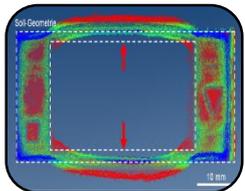
Process development

- Qualification of new materials
- Multi-material processes
- Influences of process gas



Process observation

- Thermography
- High-Speed recording
- Analyzation of the back-scattered electrons (EBM)



Simulation

- Structure Simulation
- Process Simulation
- Material flow simulation

Competences for research and industry cooperation

- Potential assessment of the additive technology in specific use-case
- Conception and design of additive process chains
- Modification of the process or the equipment
- Structure and Process Simulation
- Metallographic investigations
- Load and manufacturing compliant part design



The additive manufacturing laboratory AMLab

History of the AMLab

- Ongoing research in the field of additive manufacturing at the *iwb* Augsburg since 1995.
- With the founding of the project group RMV of the Fraunhofer IWU in the year 2010 the additive manufacturing becomes a common focus of activity.
- The brand name AMLab is used to bundle the activities of both institutions in this field.
- A intensive knowledge exchange takes place, many research and development projects are handled together.
- All in all results one of the biggest additive manufacturing laboratories in south Germany.



The additive manufacturing laboratory AMLab

manufacturing machines

Metal

Concept Laser

M1 Cusing

150 x 150 x 250 mm



Concept Laser

MLab

90 x 90 x 80 mm



EOS

M270 Xtended

250 x 250 x 250 mm



EBM

Self developed

Ø 80 mm bei 10 mm Höhe



SLM Solutions

MTT SLM 125HL

125 x 125 x 125 mm



SLM Solutions

MTT SLM 250HL

250 x 250 x 350 mm



Polymers and non-metallic materials

EOS

Formiga P 100

200 x 250 x 330 mm



Stratasys

µPrint SE Plus

203 x 203 x 152 mm



Voxeljet

Testaxis

110 x 250 x 95 mm



Testing and analysis apparatus

Tensile and bending

Zwick Roell Z100



Roughness

Mitutoyo SJ-401



Oxygen/Hydrogen cont.

Burker
G8 Galileo



Hardness

Zwick Roell ZHU/Z2.5



Surface

Keyence VK-X7000



Deformation

Steinbichler Comet L3D



Surface/Element distribution

REM/EDX



Deformation

Leitz Reference 600
coordinate measuring



Additive Manufacturing

Your contact



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Process Development

Analysis, development and qualification of manufacturing processes and materials



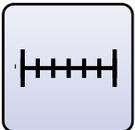
Process strategy

e.g. Development of recoating mechanisms and machine concepts for the multi-material processing



Process control

e.g. Determination of suitable parameters for the reliable processing of magnesium



Dimensional accuracy

e.g. Development of compensation methods for avoiding warpage-based deformations



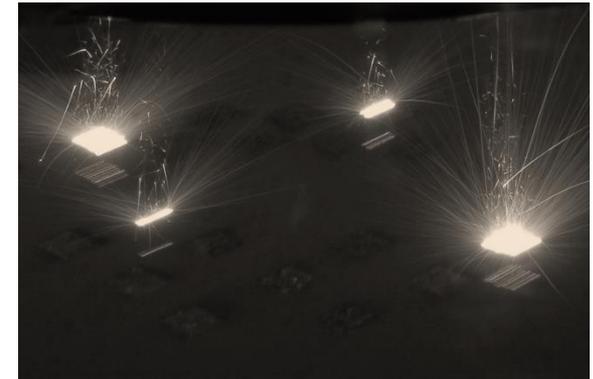
Metallography

e.g. Evaluation of the microstructure by means micrographs and hardness mapping of additively manufactured samples



Feasibility studies

e.g. Manufacturability of components for the aerospace industry of high performance materials

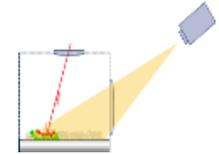


Selected Methods:

- Design of Experiments
- Metallography
- Process analytics (in-process, post-process)

Process monitoring

Development and qualification of new process monitoring systems to increase Process understanding and for the detection of defects



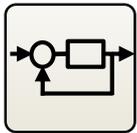
Planing and Designing

e.g. Selection of suitable measuring systems and adjusting of machine components for process monitoring



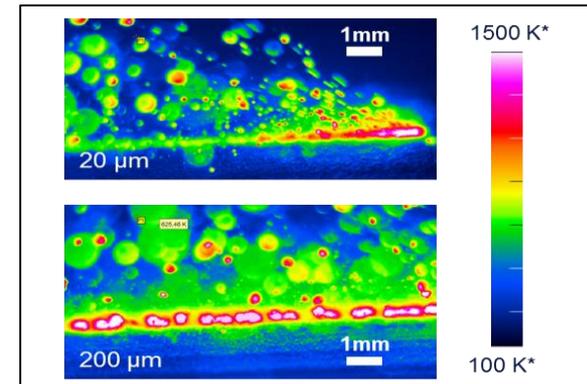
Quality control

e.g. Inline quality control by layer-images and image analysis on potential defects



Automated evaluation of measurement results

e.g. Development of software for the extraction of defect information from thermographic recordings

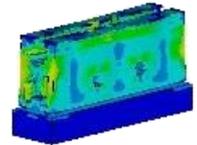


Selected Methods:

- Image processing
- CAx
- Softwaredesign
- FMEA

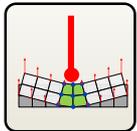
Simulation

Modeling and Simulation for the description and design of additive manufacturing process and the resulting process and component properties



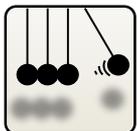
Process simulation

e.g. Simulation of melt pool flows in Laser Beam Melting



Structural simulation

e.g. thermo-mechanical Simulation of residual stresses and distortions



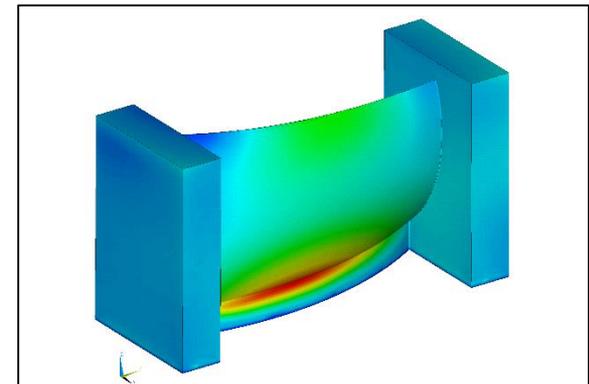
Experimental verification of results

e.g. measurement of the residual stresses in the component by neutron diffractometry



Material flow simulation

e.g. Analysis of existing procedures for modeling and verification of the simulation. Opportunities for capacity planning and illustration of potential future scenarios



Selected Methods:

- Finite Element Method
- Smoothed Particle Hydrodynamics
- Plantsimulation