Dear Madam or Sir,

Modern additive manufacturing processes, using laser or electron beams as the means of melting, provide a potential for changing the design approach from 'design for manufacturing' to 'design for performance'. Therefore you can design your part for optimized performance without worrying for the manufacturing limitations. Additive manufacturing is capable for manufacturing every design which you can imagine. The approach favors not only design optimization, but also a shorter time to market, as the designed product can be manufactured within hours without need of any molds or tooling.

However, there can be certain issues, depending on the material and geometry, which need to be addressed before a component can be put into service. There can be surface issues, influence of remnant defects, residual stresses as well as compatibility of the process parameters for the designed component. These issues, if left unaddressed, can affect the reliability of industrial parts.

Materials Test Engineering at TU Dortmund University has the expertise to deal with these issues, and recommend the processing and post-processing treatments which could improve the performance of your component. Equipped with measurement techniques and the test facilities, we provide you with the reliable material characteristics for additive-manufactured parts.

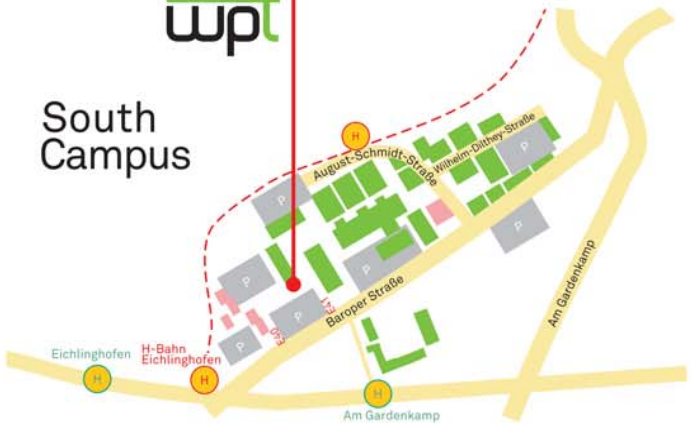
With best regards,

Yours

Prof. Dr. Frank Walther

wpt

South Campus



M.Sc. Jochen Tenkamp
Phone +49 231 / 755-8425
jochen.tenkamp@tu-dortmund.de

M.Sc. Mustafa Awd
Phone +49 231 / 755-8423
mustafa.awd@tu-dortmund.de

TU Dortmund University
Dept. of Materials Test Engineering (WPT)
Baroper Str. 303
D-44227 Dortmund, Germany
Phone +49 231 / 755-8028
Fax +49 231 / 755-8029
mail@wpt-info.de
www.wpt-info.de

technische universität dortmund

Reliability in Additive Manufacturing

wpt

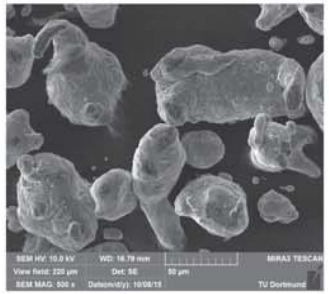
www.wpt-info.de

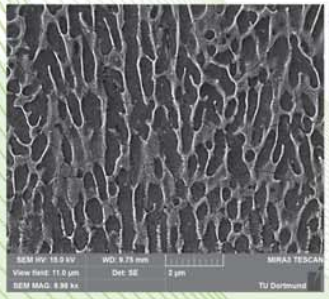
Faculty of Mechanical Engineering

Pre-process

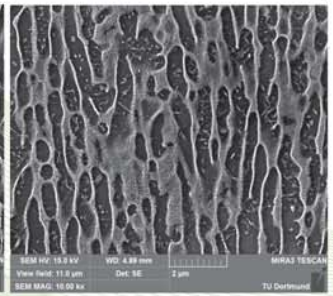
Process-specific issues

- Un-melted powder particles
- Surface roughness
- Residual stresses
- Reduced ductility
- Fatigue scatter





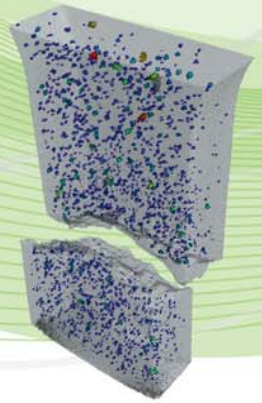
No base plate heating
dendrite width 0.35 µm



Base plate heating
dendrite width 0.56 µm

Goals

- Reduction of porosity
- Grading for properties
- Control of residual stresses
- Control of microstructure
- Retardation of cracks
- Morphology optimization

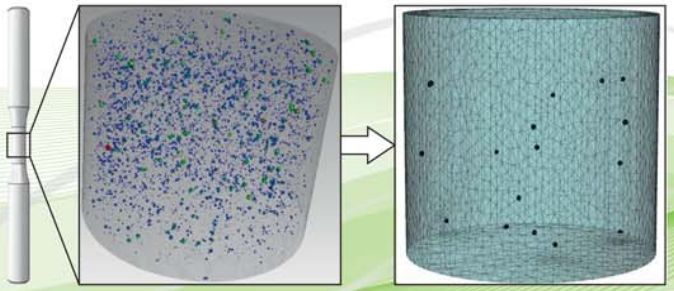


Aluminium

In-process

Means

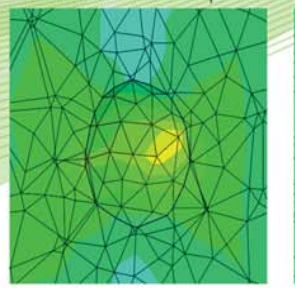
- In-situ damage monitoring
- Imposed thermal conditions
- Corrosion analysis
- FE modelling of damage
- Fatigue testing into VHCF
- Phenomenological damage monitoring



PEEQ
(Avg: 75%)

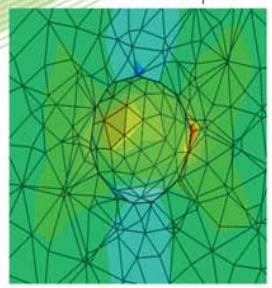
0.038
0.035
0.031
0.028
0.025
0.022
0.019
0.016
0.013
0.009
0.006
0.000

Pore size = 110 µm



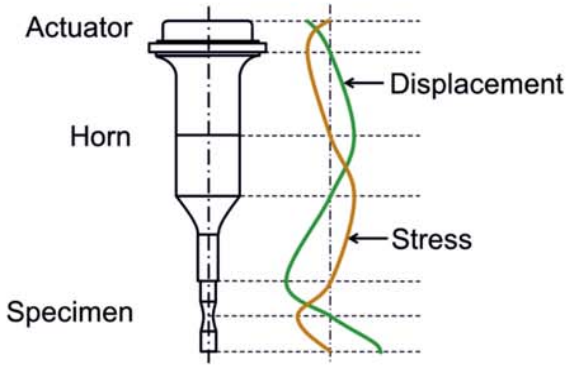
PEEQ = 0.029

Pore size = 90 µm



PEEQ = 0.038

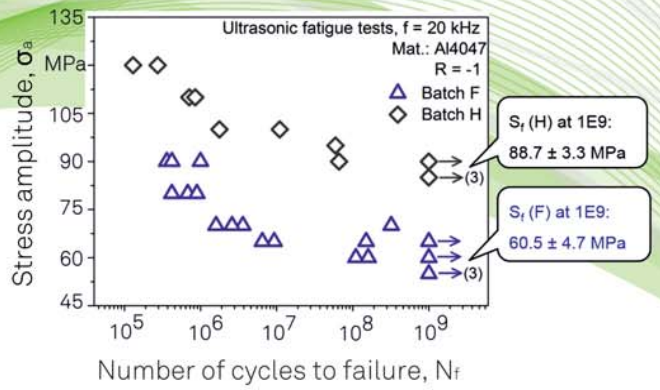
Post-process



Performance validation

- Ultrasonic frequency using piezo-electric actuators
- Cyclic speed damage mechanism
- Understanding crack initiation conditions

Batch F: Stress relief
Batch H: Base plate heating + stress relief



Qualification