aconity

Effects of Beam Shaping on L-PBF Processes Stability – Productivity – Material Properties

EPIC Online Meeting, 07.03.2022

Florian Eibl, Marco Beckers, Martin Buscher
Rob Martinsen
Christian Schröter

Aconity3D GmbH, Herzogenrath, Germany
nLIGHT, Inc., Vancouver, USA
Optoprim Germany GmbH, Unterschleißheim, Germany

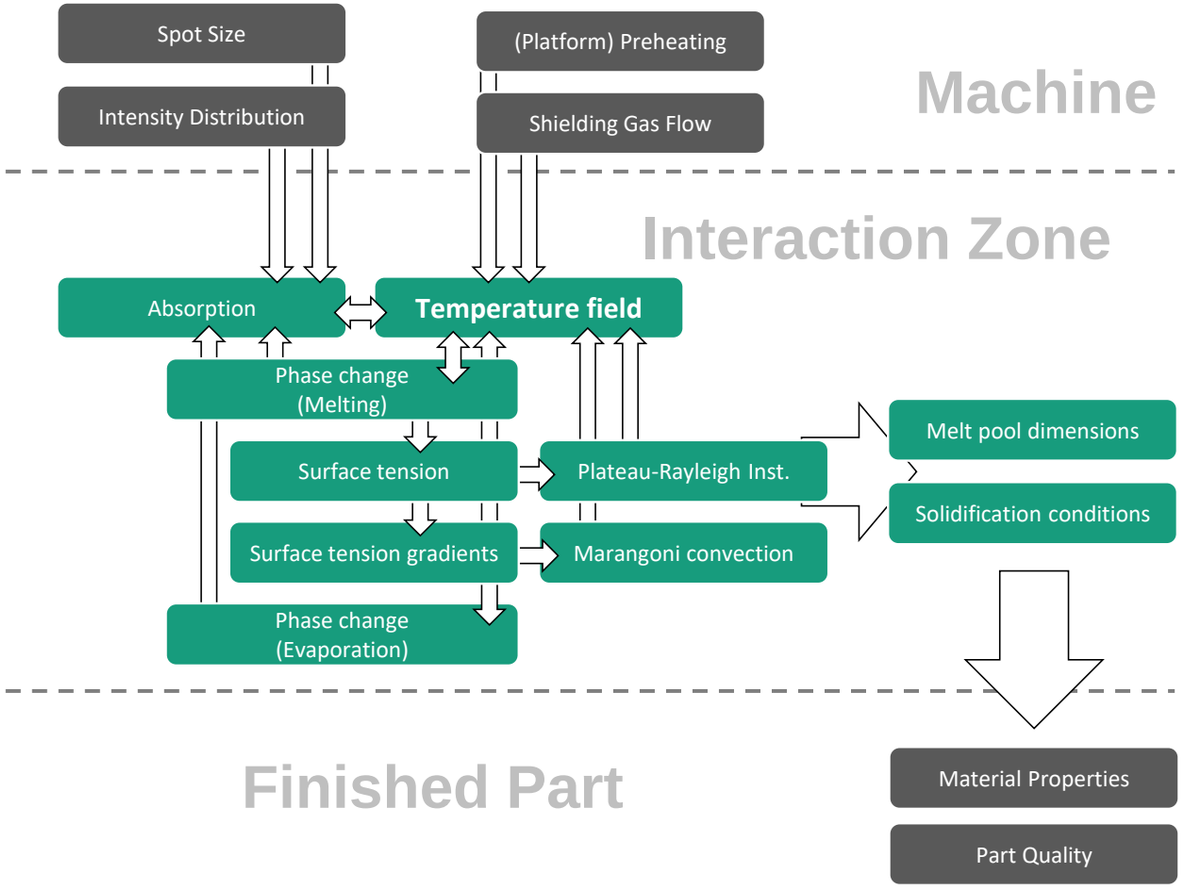
Today’s objectives

- **Motivation**
  - Beam shaping reinvented
- **Current state of investigations**
  - Processing
  - Mechanical Properties
  - Metallography
  - Simulation
- **Summary**

Introduction

L-PBF is complex!

- Interaction of various effects
- Many influencing factors
- Not fully understood (yet)



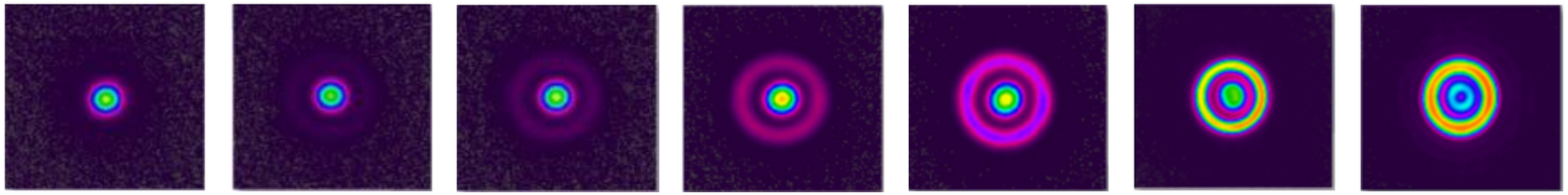
Knowledge about and control over parameters is crucial

Laser-integrated Beam Shaping

AFX Programmable Beam Control

	Index 0	Index 1	Index 2	**Index 3**	Index 4	Index 5	**Index 6**	
Ring	0	24	37	54	74	84	89	[%]
Center	100	76	63	46	26	16	11	[%]
Maximum	600	700	800	1050	1235	1235	1235	[W]

Single-mode spot size
d_o = 130 µm



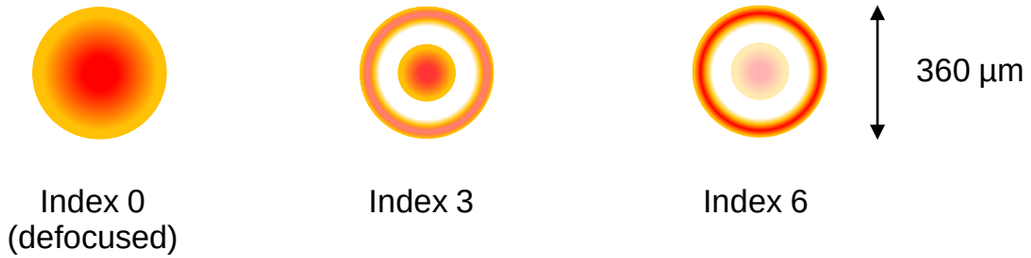
Ring-mode spot size
$3d_o$ = 360 µm

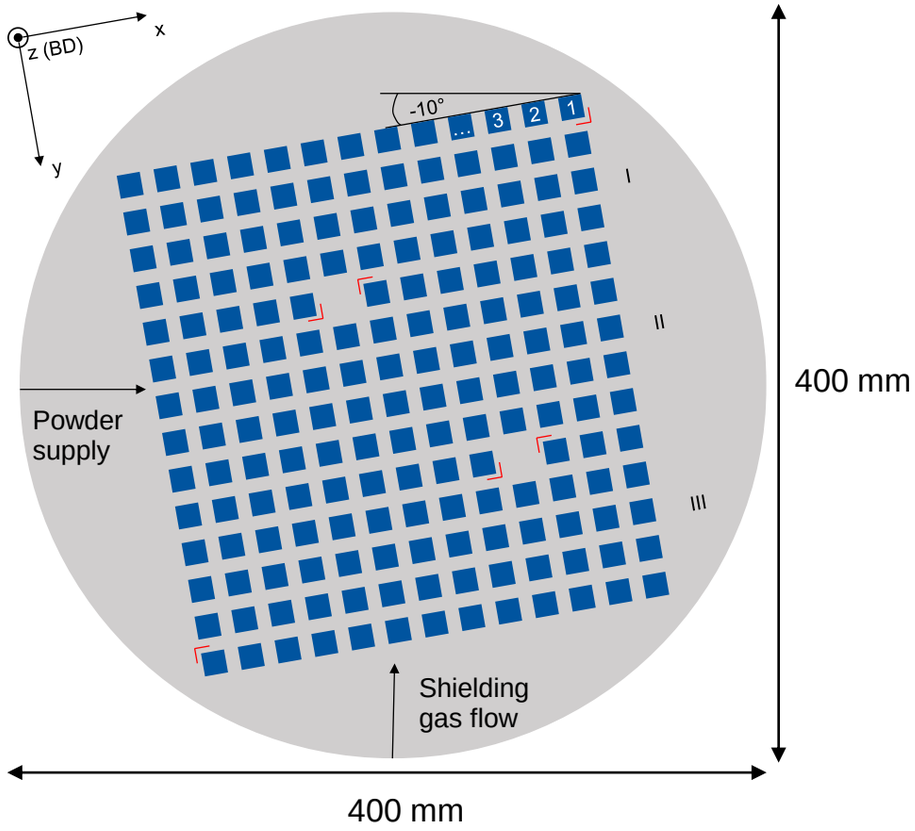
Intensity Distribution as additional process parameter

Experimental Setup and Procedure

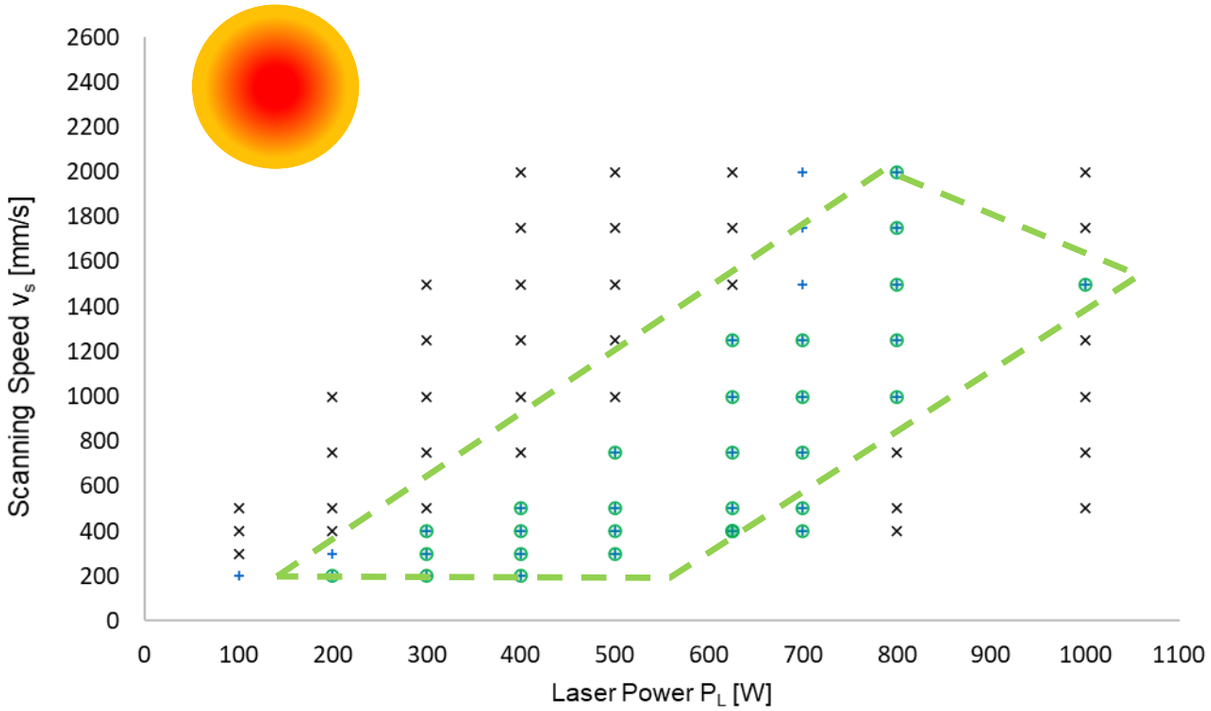
AconityONE²

- IN718
- Six runs, 180 samples (10x10x10 mm³) each
  - Power P_L (200-1000 W)
  - Scan speed v_s (100-2000 mm/s)
  - Hatch distance Δy_s (150, 200 and 250 µm)
  - Layer thickness d_Z (50 and 100 µm)
- Index 0 defocused
  → matching spot diameters

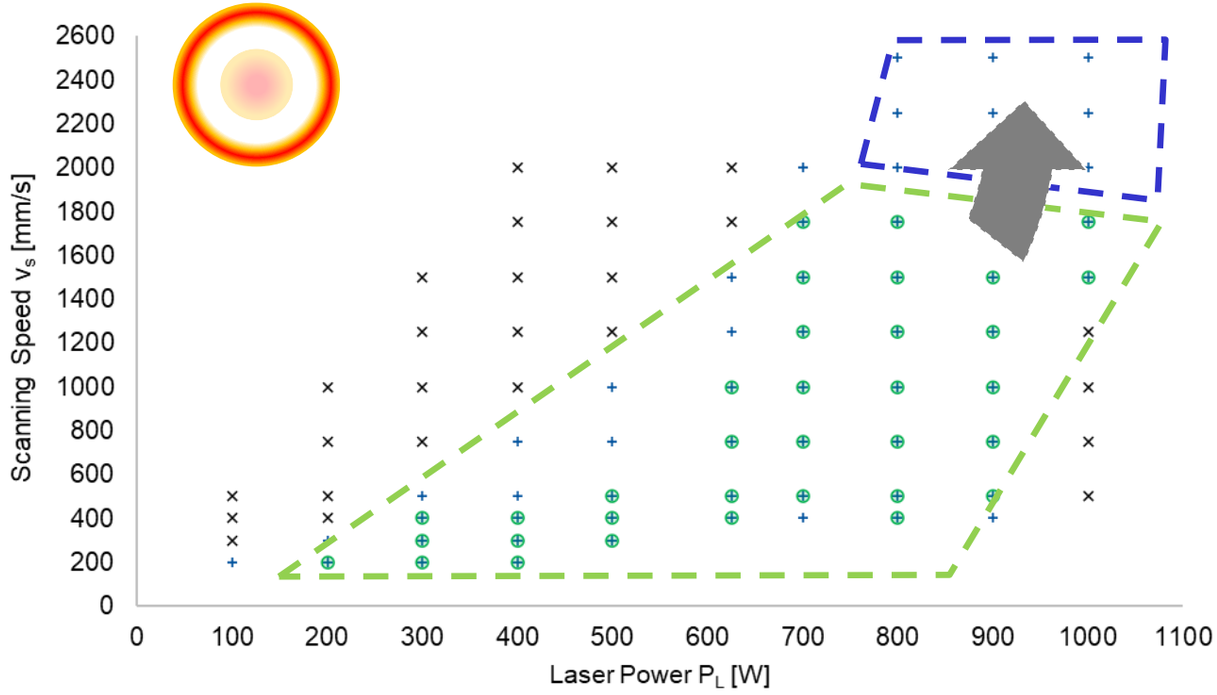




Results – Processing Windows



Index 0, Δy_S = 150 µm, d_Z = 50 µm

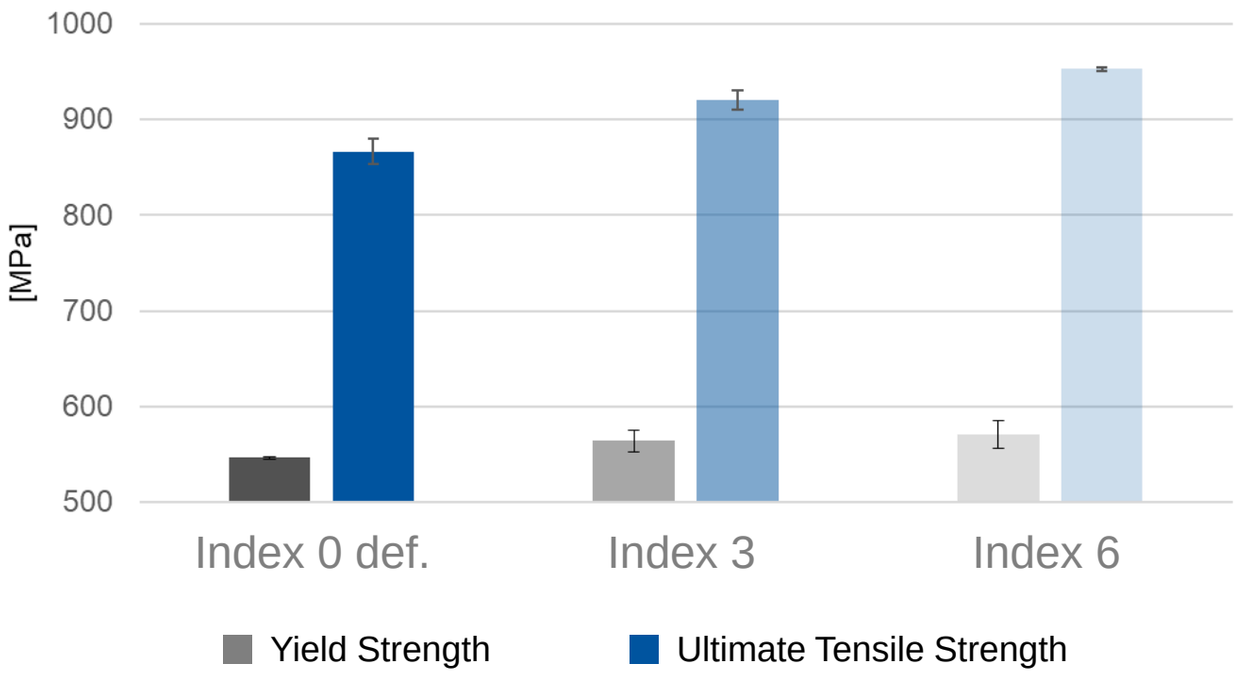


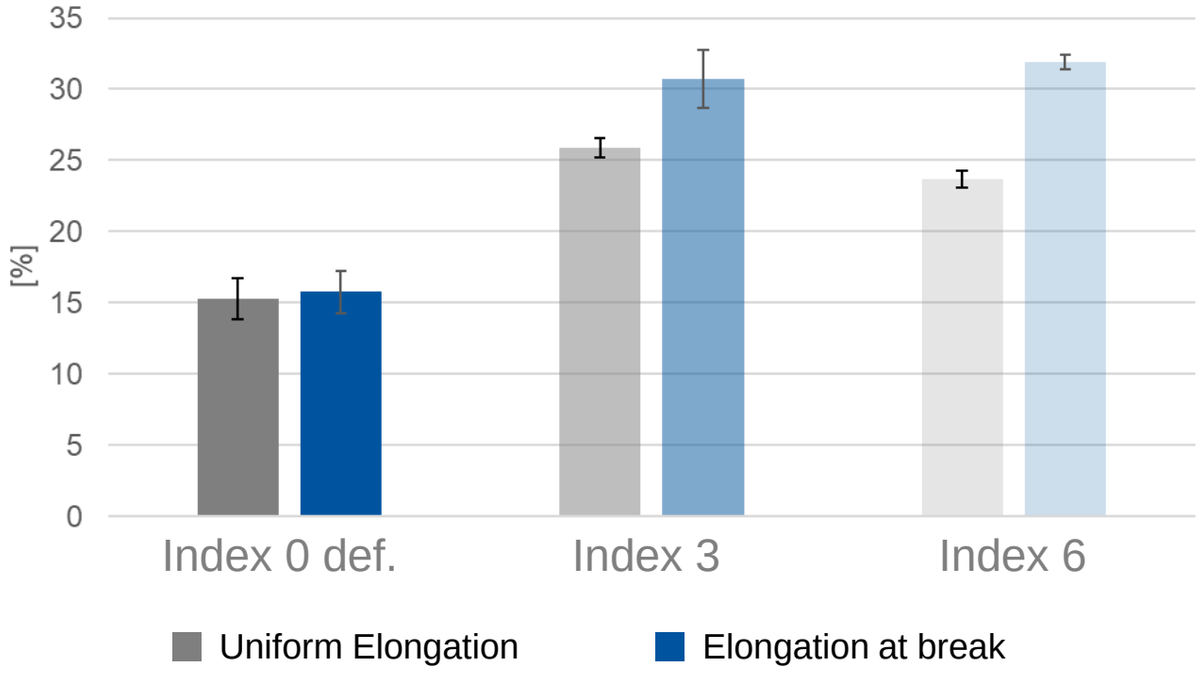
Index 6, Δy_S = 150 µm, d_Z = 50 µm

Process stability increased with ring mode intensity distribution

× not processable + processable ○ Density > 99,5%

Results – Mechanical Properties

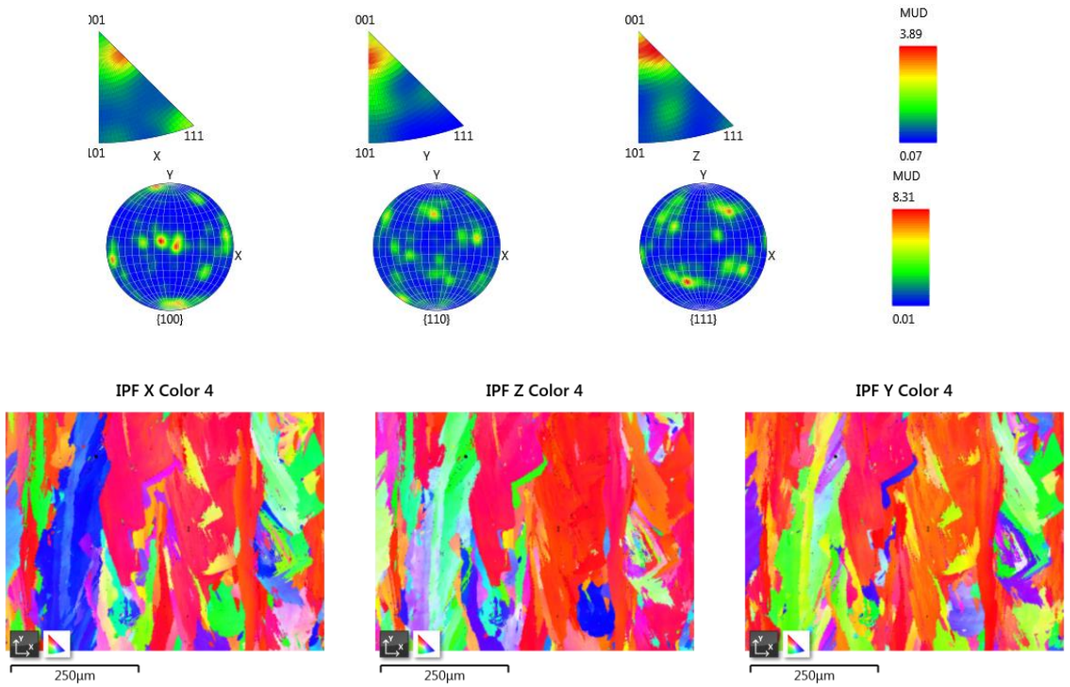




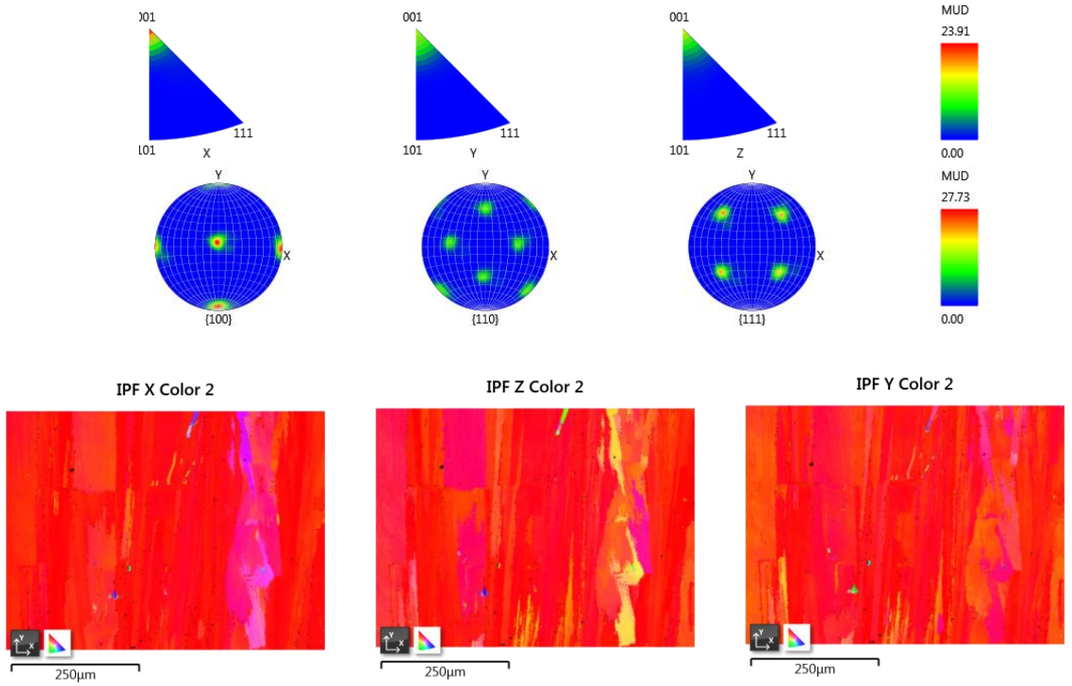
Tensile Strength AND Elongation increased for Index 6 processing

P_L = 700 W, v_S = 1250 mm/s, Δy_S = 150 µm, d_Z = 50 µm, n = 3

Results – Metallography SEM/EBSD



Index 0, defocused



Index 6

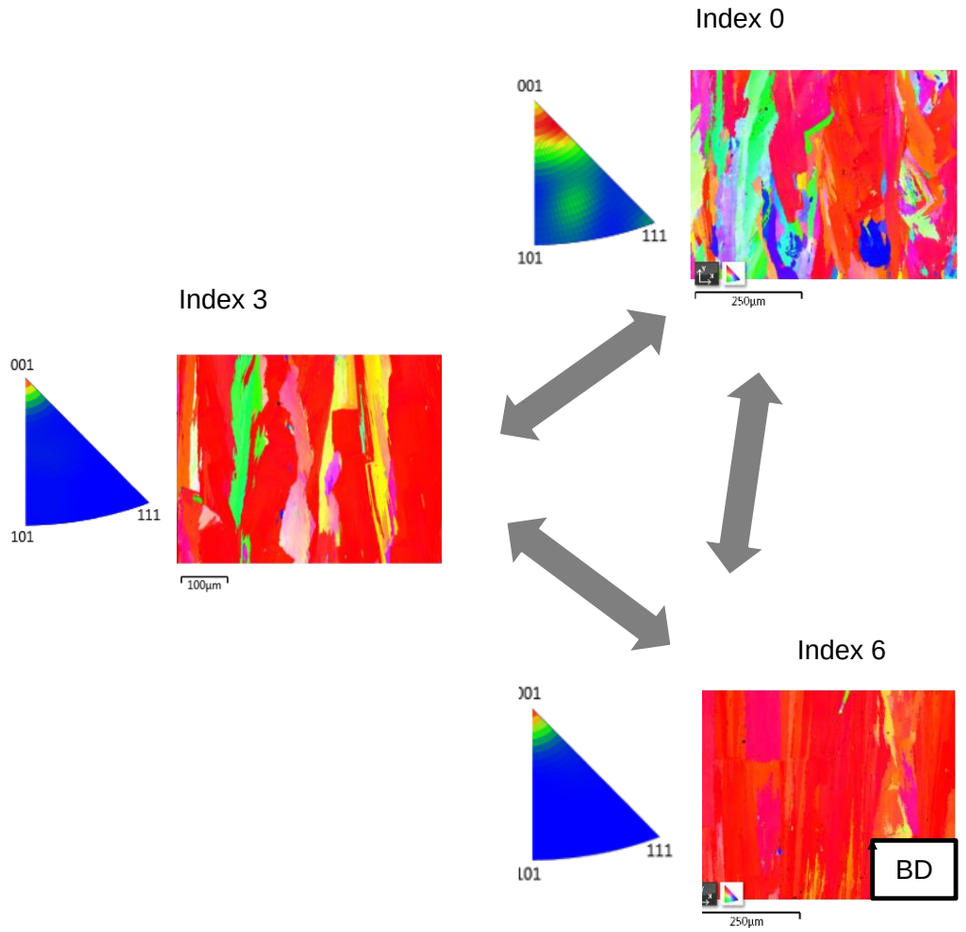
Strong preferential orientation <001> and sharp texture for Index 3 & 6

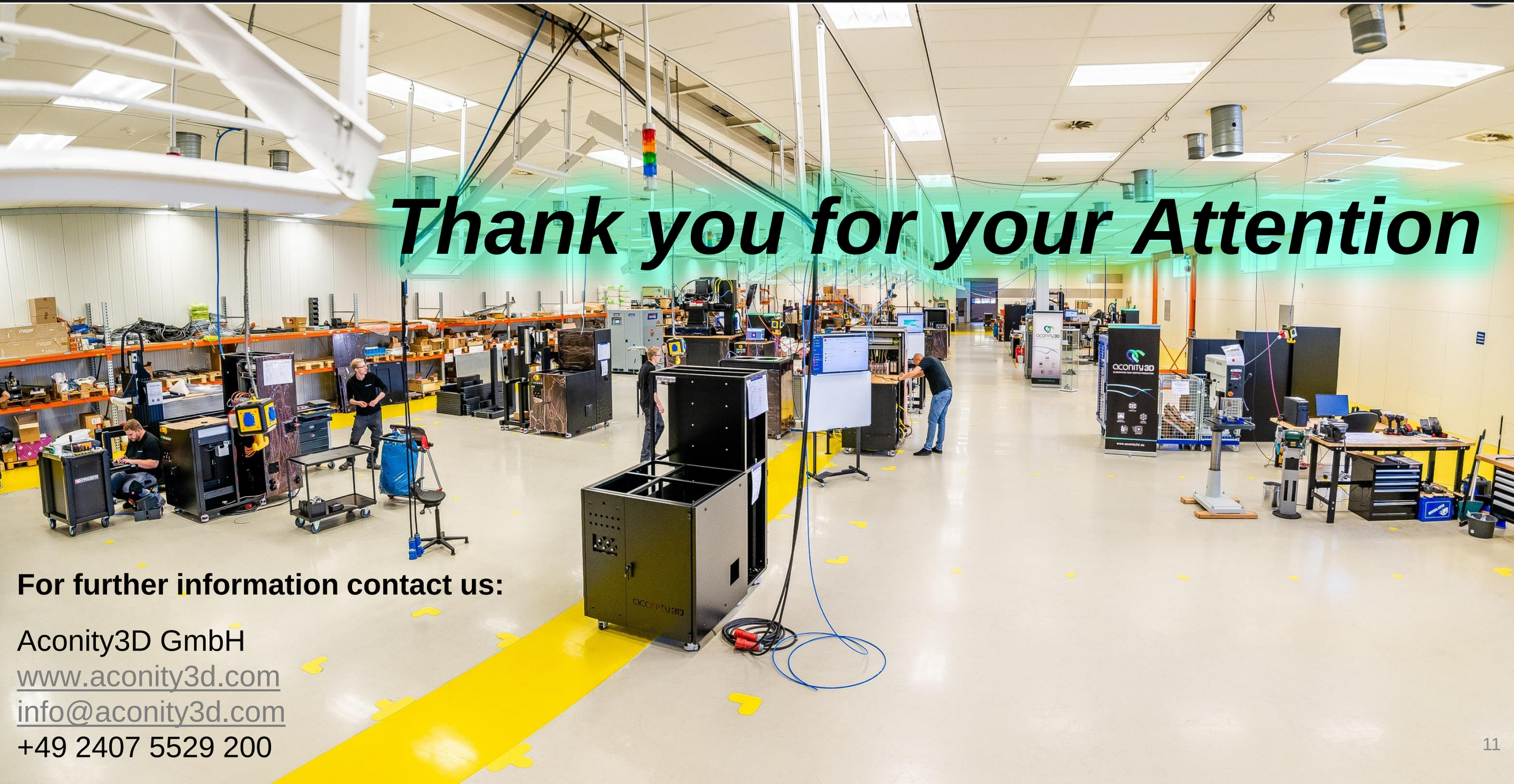
P_L = 700 W, v_S = 1250 mm/s, Δy_S = 150 µm, d_Z = 50 µm, n = 3

Conclusion

Freedom to Operators!

- Targeted adjustment of texture and mechanical properties via different laser intensity distributions
- More control over melting track shape & stability
- Within build jobs, within layers, within parts





Thank you for your Attention

For further information contact us:

Aconity3D GmbH
www.aconity3d.com
info@aconity3d.com
+49 2407 5529 200