Surface treatments for additive manufacturing components

iFAST Annual Meeting

Workshop on Additive Manufacturing (AM) applications

05.05.2022

Shot Blasting

Mass Finishing

AM Solutions

Rösler Oberflächentechnik GmbH

Ing. Matteo Pozzi

Chemical and Technological LAB – R&D

RÖSLER AROUND THE WORLD

+80 Years
Experience across many industries

16 Branches

+150 Distributors globally

Surface engineering

Mass finishing

Shot blasting

Machines

Media

Compounds

Surface engineering

Mass finishing

Shot blasting

AM solutions

Machines

Media

Compounds

MASS FINISHING

Machine

VIBROFINISHING

MASS FINISHING

Media

Machine

VIBROFINISHING

MASS FINISHING

Media

Compounds + water

Machine

VIBROFINISHING

MASS FINISHING

Components to be finished

Media

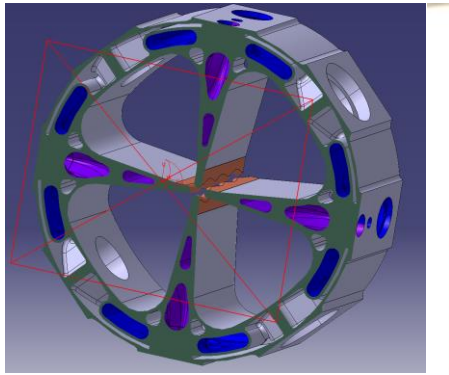
Compounds + water

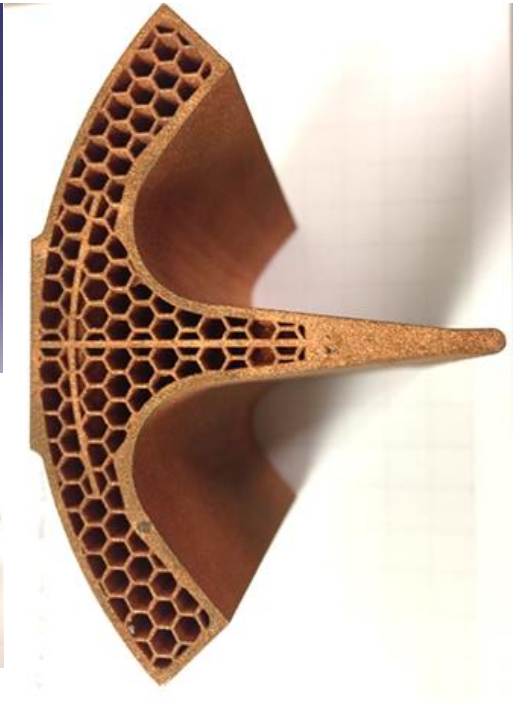
Machine

VIBROFINISHING

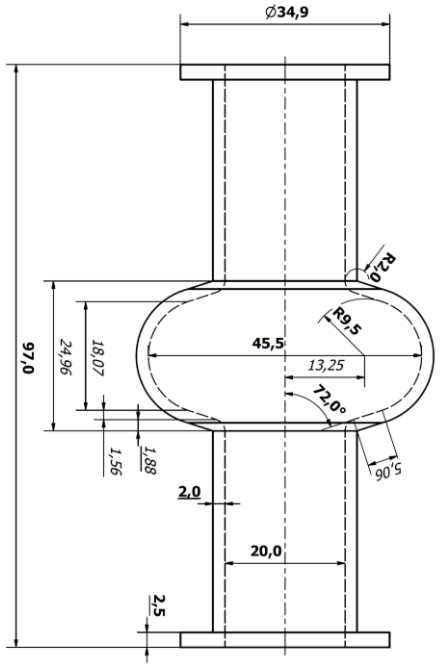
RÖSLER CONTRIBUTION IN IFAST WP 10

Task 10.2: RFQ





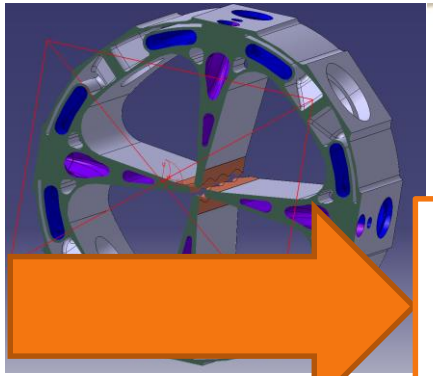
Task 10.4: SRF

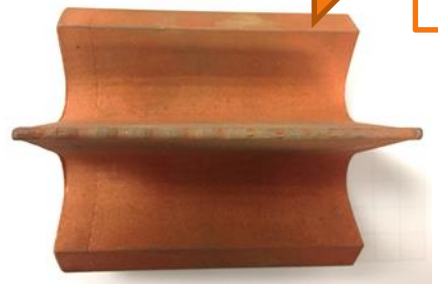


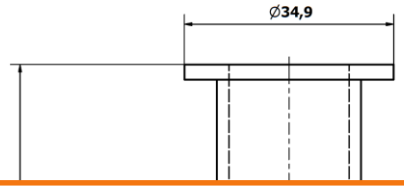
RÖSLER CONTRIBUTION IN IFAST WP 10

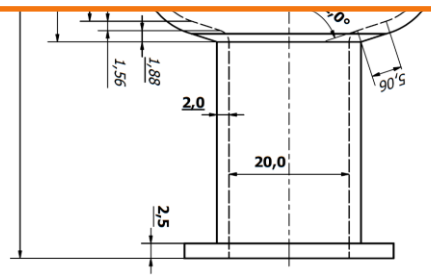
Task 10.2: RFQ

Task 10.4: SRF



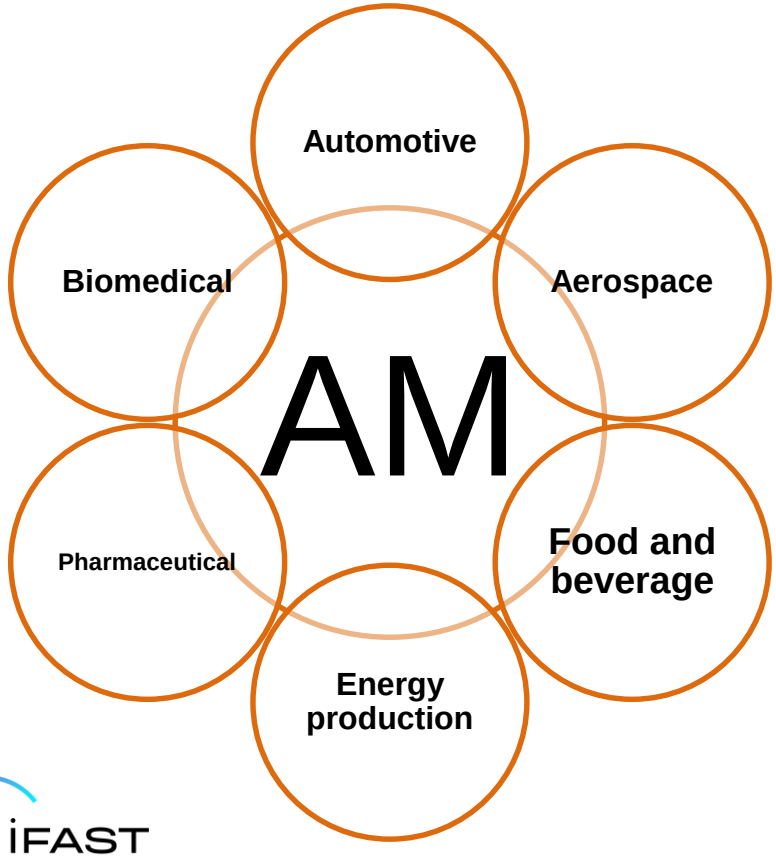






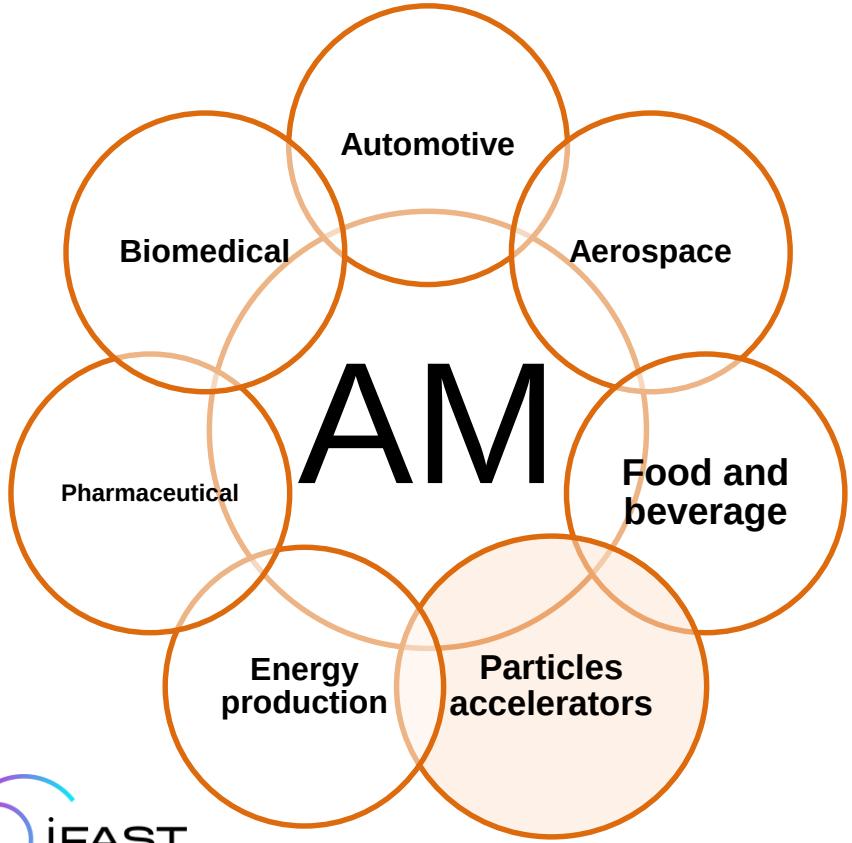
Surface finishing is needed to make these objects properly working

SURFACE FINISHING OF AM COMPONENTS



- Aluminium alloys (AlSi7, AlSi10Mg)
- Stainless steel (AISI 316 L)
- Titanium alloys (Ti6Al4V)
- Nichel alloys (Inconel 718, 625)

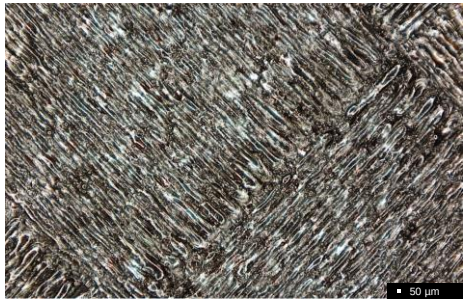
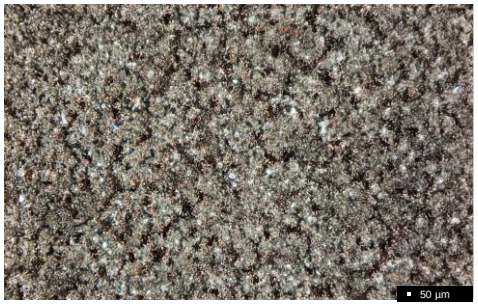
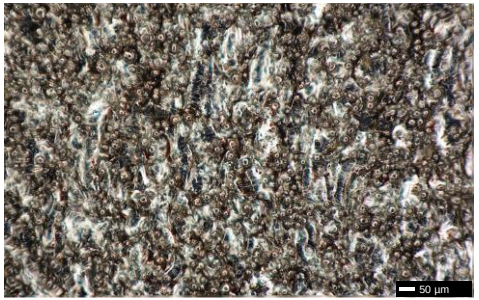
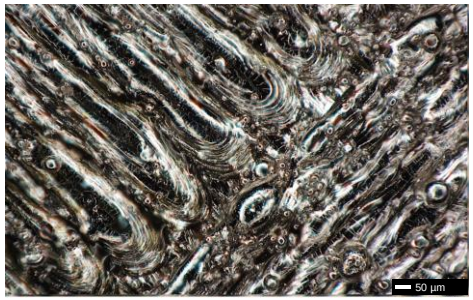
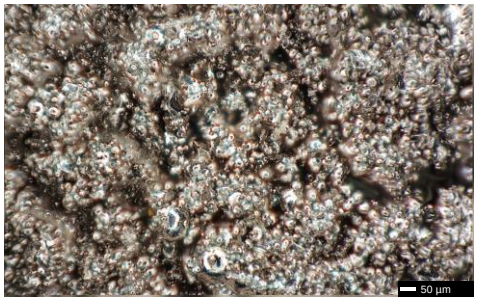
SURFACE FINISHING OF AM COMPONENTS



- Aluminium alloys (AlSi7, AlSi10Mg)
- Stainless steel (AISI 316 L)
- Titanium alloys (Ti6Al4V)
- Nichel alloys (Inconel 718, 625)
- Pure Copper

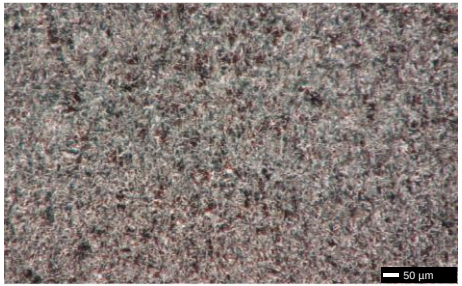
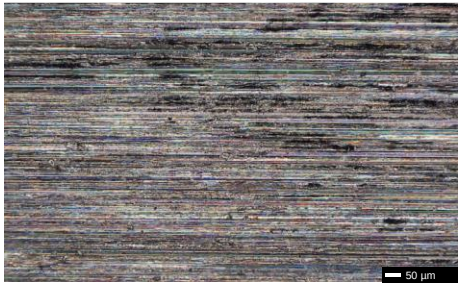
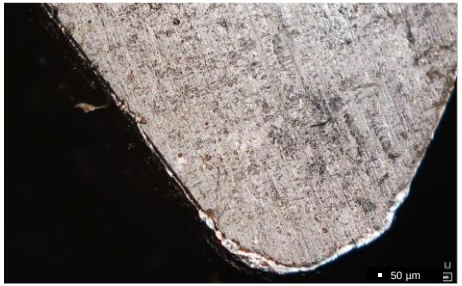
SURFACE FEATURES OF AM COMPONENTS

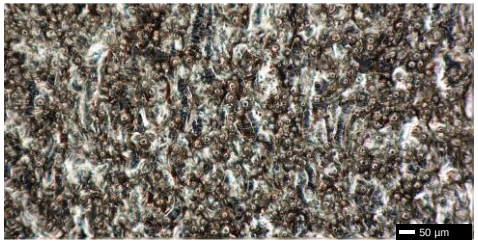
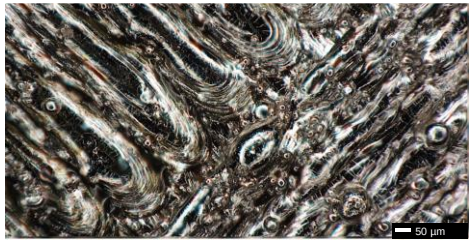
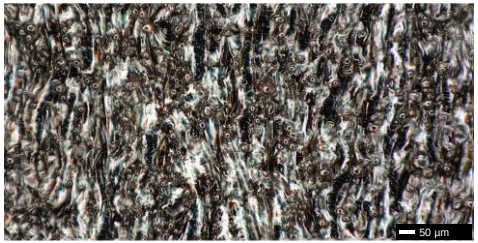
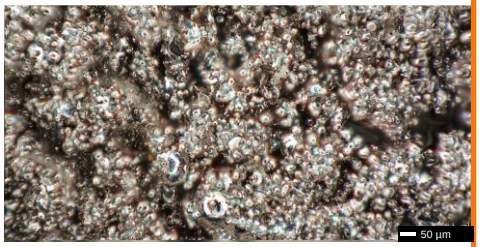
AISI 316 L

Vertical surface	Horizontal surface	45° upskin	45° downskin
			
			

SURFACE FEATURES OF AM COMPONENTS

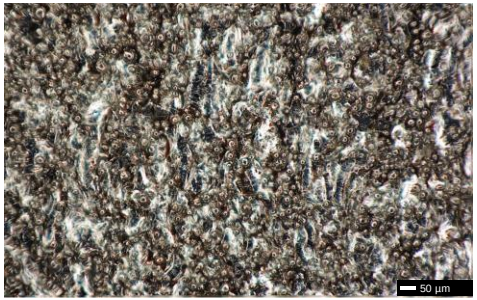
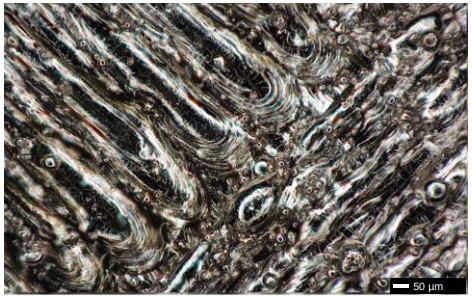
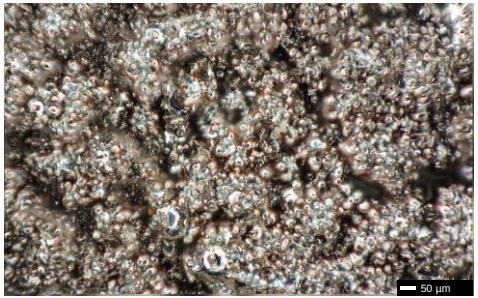
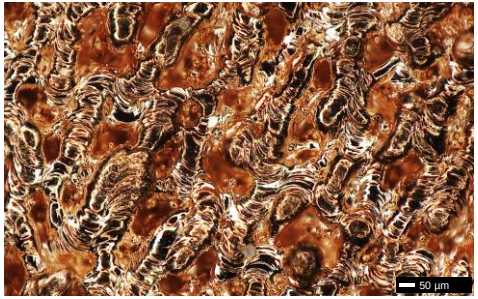
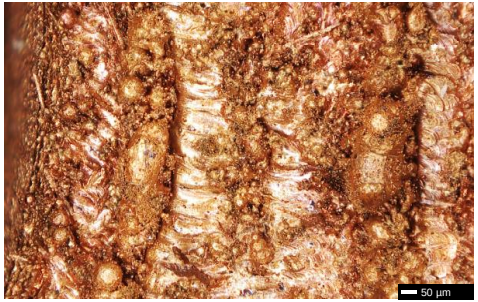
Traditional manufacturing technologies

Injection moulding	Milling	Turning	Blanking
			

Vertical surface	Horizontal surface	45° upskin	45° downskin
			

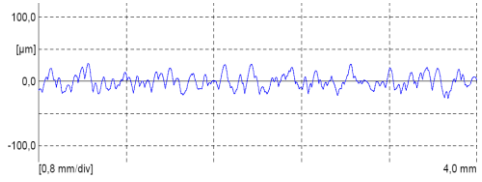
Additive Manufacturing

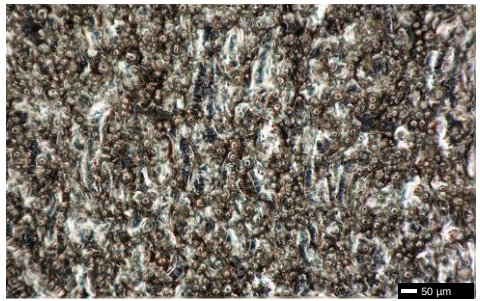
SURFACE FEATURES OF AM COMPONENTS

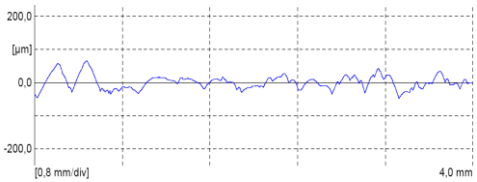
	Vertical surface	Horizontal surface	45° downskin
Stainless steel AISI 316 L			
Pure Cu samples			

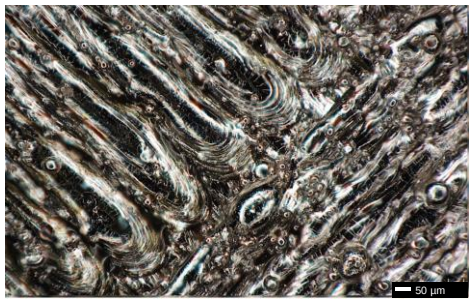
SURFACE FEATURES OF AM COMPONENTS

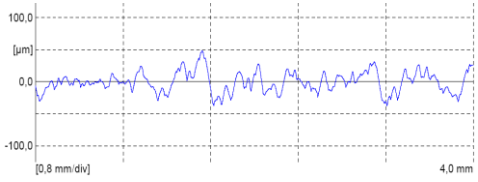
Vertical surface		Horizontal surface		45° upskin		45° downskin	
Ra (µm)	***Rz (µm)***	***Ra (µm)***	***Rz (µm)***	***Ra (µm)***	***Rz (µm)***	***Ra (µm)***	***Rz (µm)***
8,63 ± 0,26	47,19 ± 4,54	16,12 ± 0,98	79,86 ± 6,77	11,63 ± 0,83	61,05 ± 7,40	25,15 ± 0,57	114,84 ± 5,00

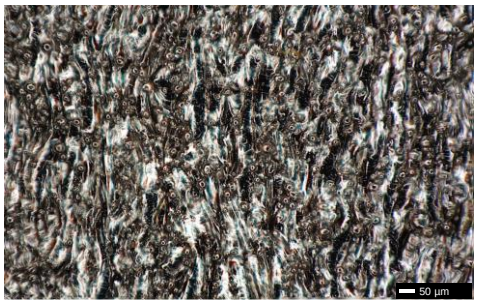


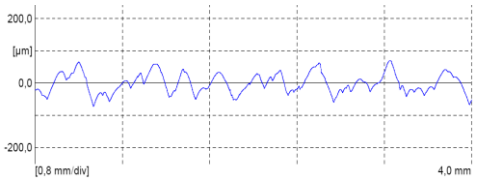


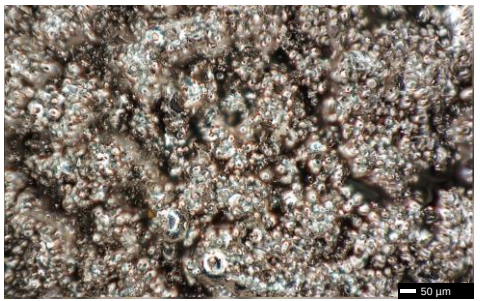












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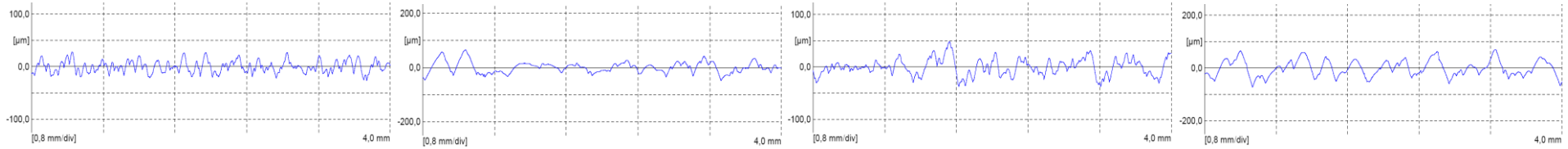
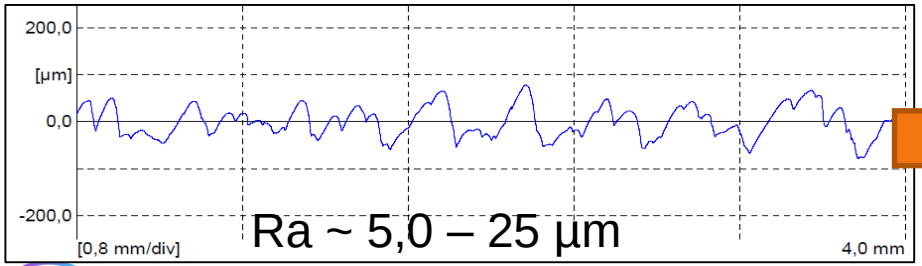
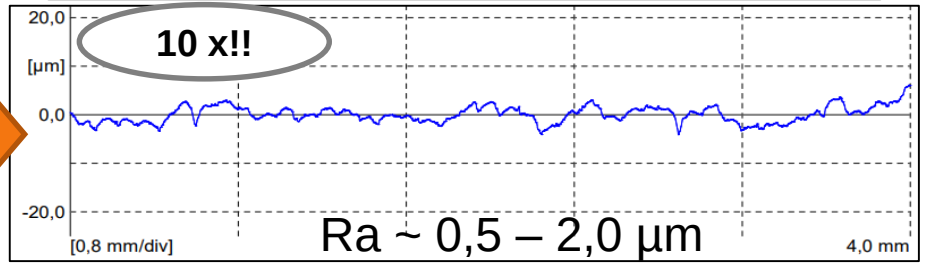


Additive Manufacturing



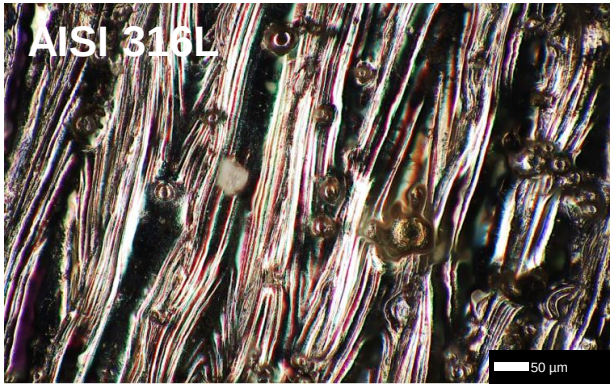
Traditional manufacturing technology

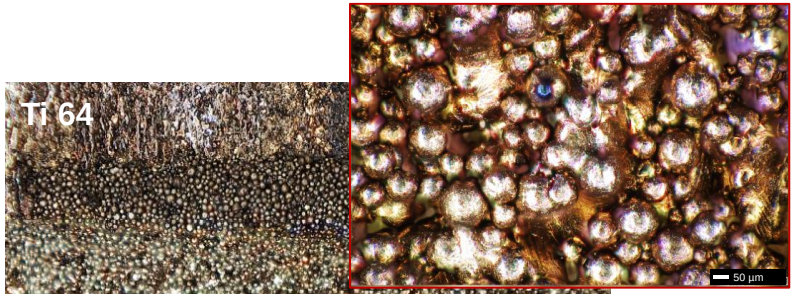


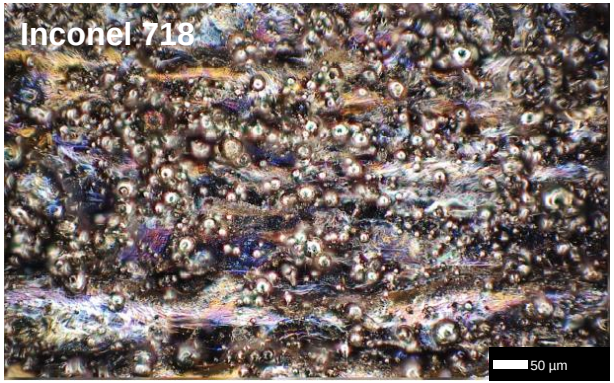
SURFACE FEATURES OF AM COMPONENTS

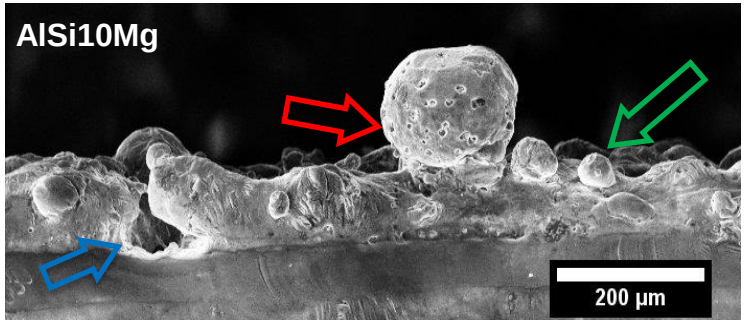
Surface defects

- Balling
- Spatters
- Cavities
- Porosity
- Laser tracks
- Partially melted powders









SEM image of surface defects of AlSi10Mg 3D printed component
M.H. Nasab, *et al*. On morphological surface features of the parts printed by selective laser melting (SLM), 2018

SURFACE FEATURES OF AM COMPONENTS

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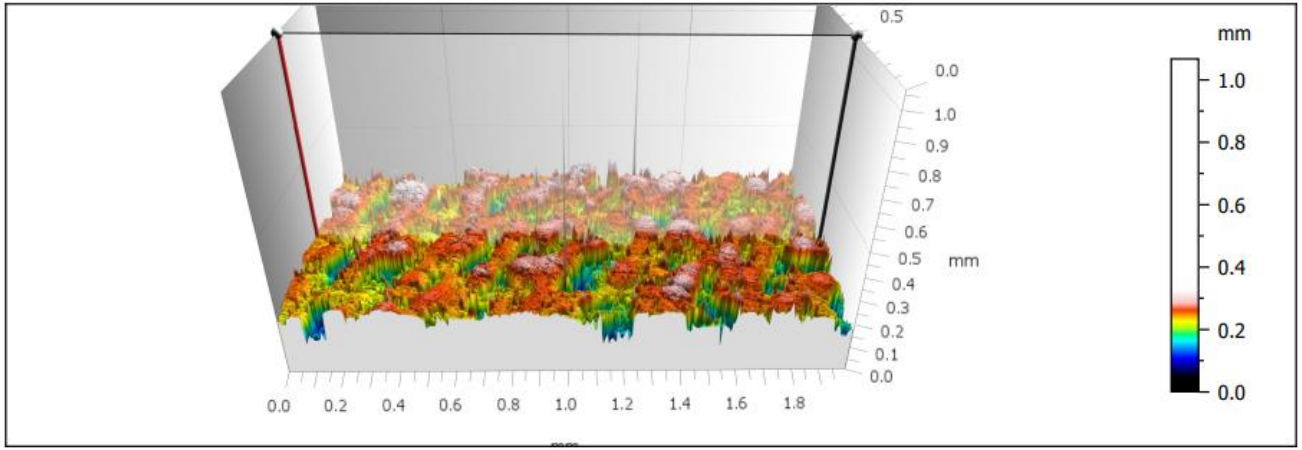
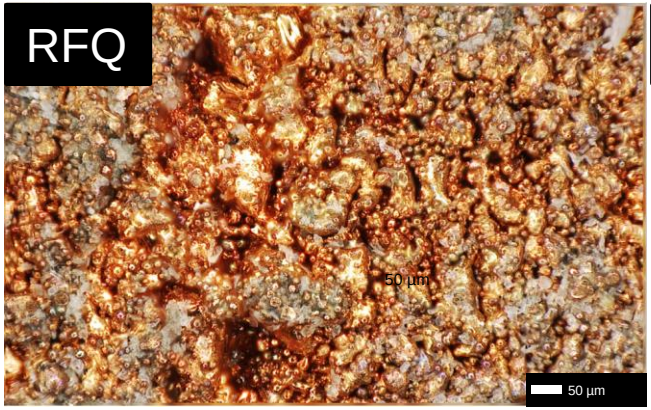


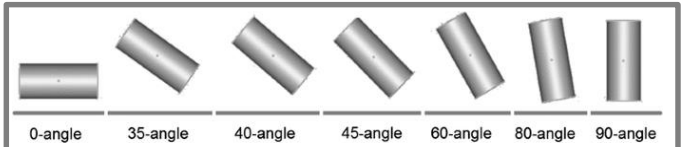


INTERNAL SURFACES

Channels and cavities

https://www.protolabs.com/resources/blog/an-intro-to-metal-additive-manufacturing-with-dmls

Dimensions

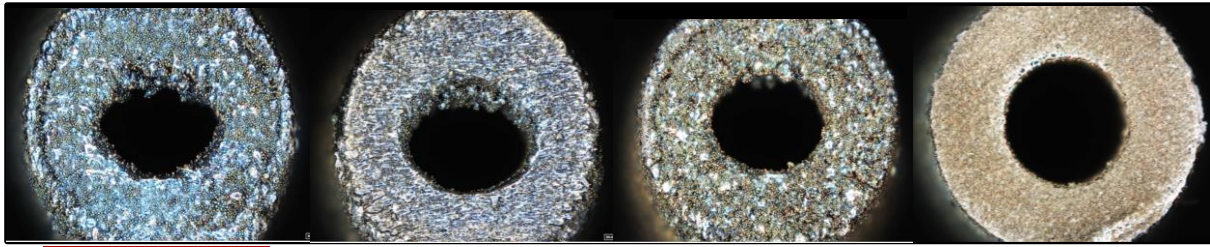


Study of Internal Channel Surface Roughnesses Manufactured by Selective Laser Melting in Aluminum and Titanium Alloys, Jukka Pakkanen *et al.*, Metallurgical and Materials Transactions A, 2016

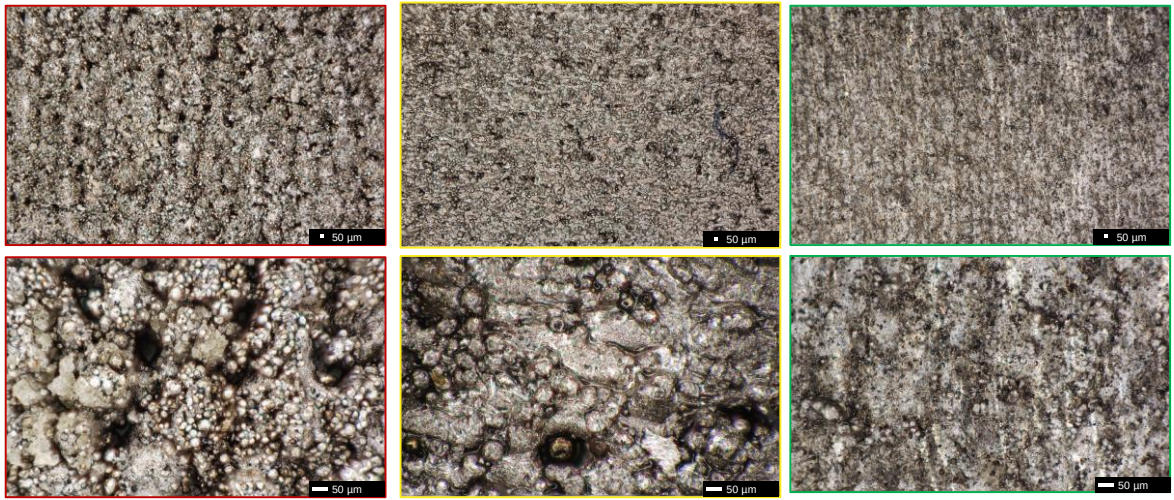
Orientation

Some examples: Heat exchanger, cooling channels, hydraulic pipes, nozzles, etc.

Inconel 718 Φ = 2 mm



0°	30°	60°	90°



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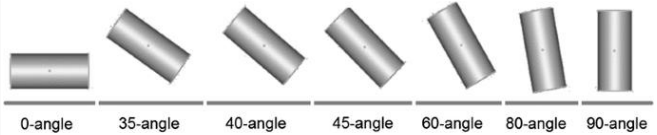

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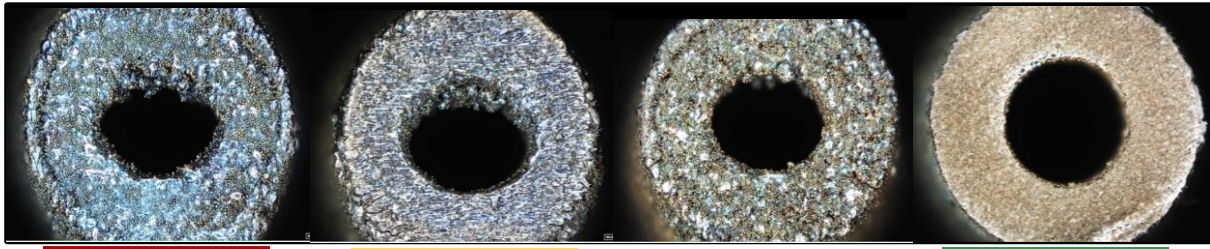
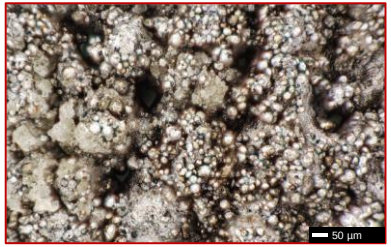
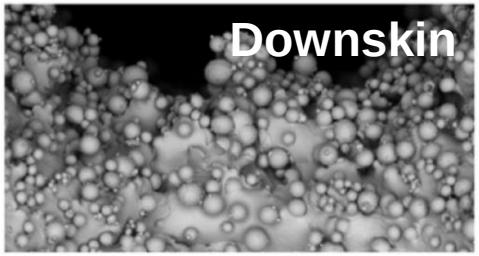


0° **30°** **60°** **90°**

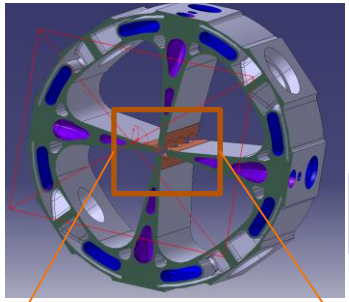


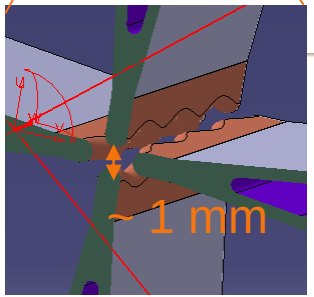


Surface and morphological modification of selectively laser melted titanium lattices using a chemical post treatment, N. Soro, *et al.*, Surface and Coatings technologies, 2020

RÖSLER CONTRIBUTION IN IFAST WP 10

Task 10.2: RFQ



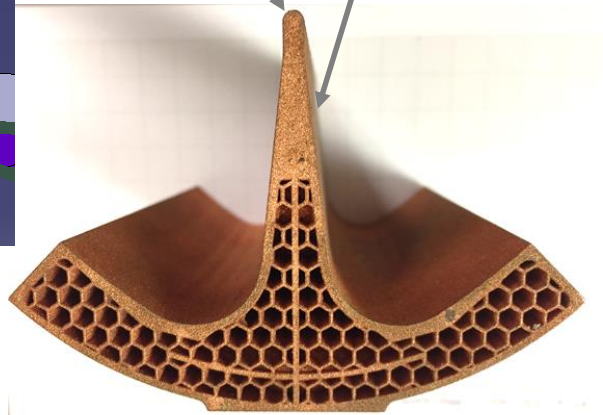


External surface

Target: Ra < 0,4 µm

Internal surface

Target: Ra < 0,4 µm



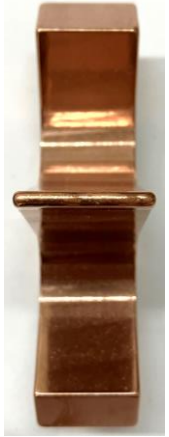
Task 10.4: SRF

Internal surface

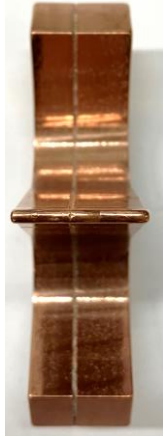
Target: Ra < 1 µm

TASK 10.2 - RFQ: SOME RESULTS

1 Traditional mass finishing process

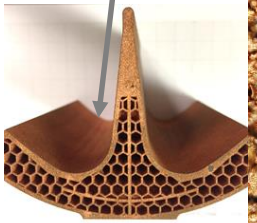


2 Chemically-assisted mass finishing process

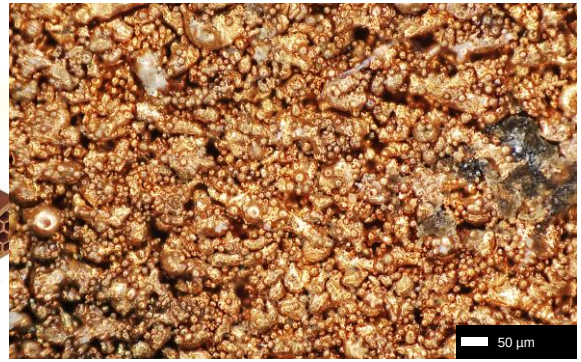


TASK 10.2 - RFQ: SOME RESULTS

Side



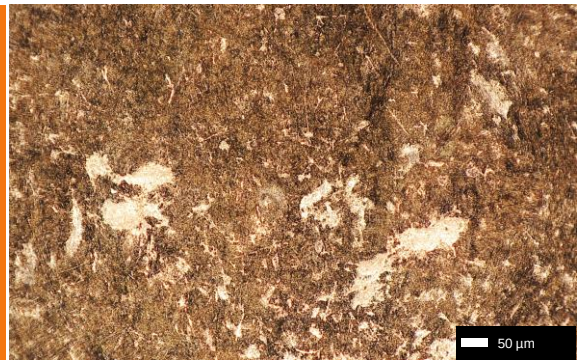
Rough sample



Ra (µm)	Rz (µm)
13,82 ± 0,83	48,86 ± 1,56

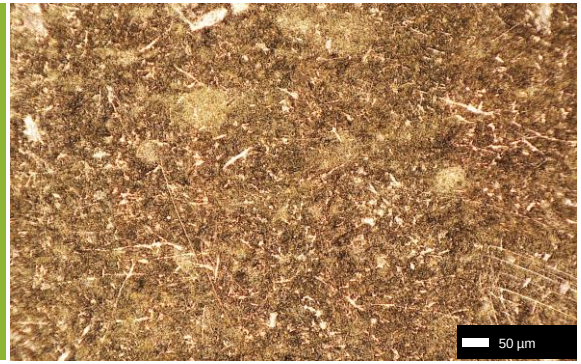
Treated sample

#1: mechanical treatment



Ra (µm)
0,28 ± 0,12
Rz (µm)
2,09 ± 0,89

#2: chemically assisted process

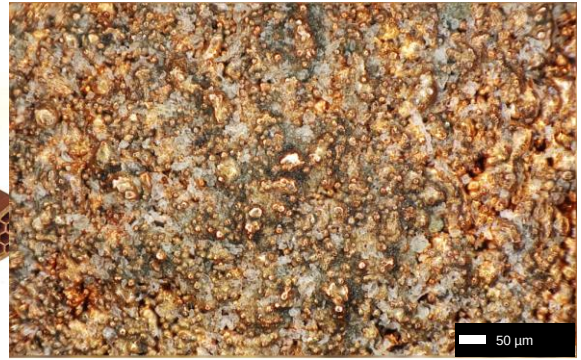


Ra (µm)
0,28 ± 0,09
Rz (µm)
1,56 ± 0,50

TASK 10.2 - RFQ: SOME RESULTS

Tip

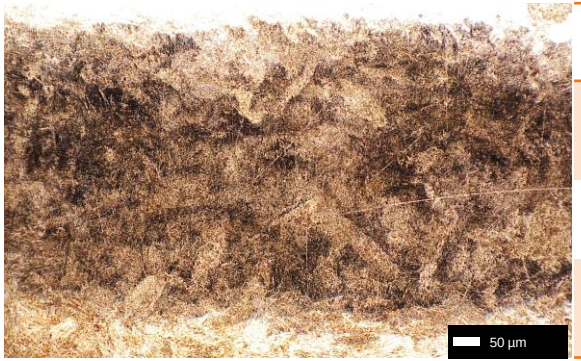
Rough sample



Ra (µm)	Rz (µm)
10,7 ± 3,1	68,7 ± 6,7

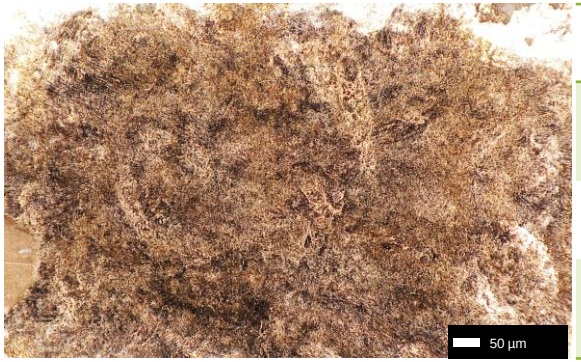
Treated sample

#1: mechanical treatment



Ra (µm)
1,58
Rz (µm)
4,98

#2: chemically assisted process

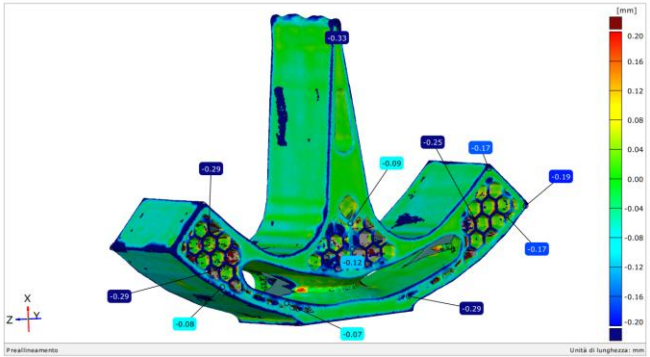


Ra (µm)
2,31
Rz (µm)
7,34

TASK 10.2 - RFQ: SOME RESULTS

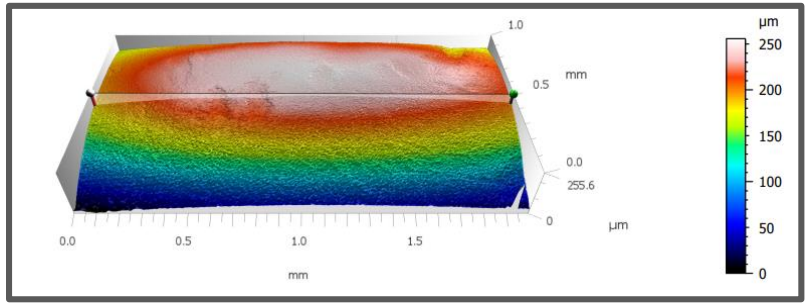
1

Tip

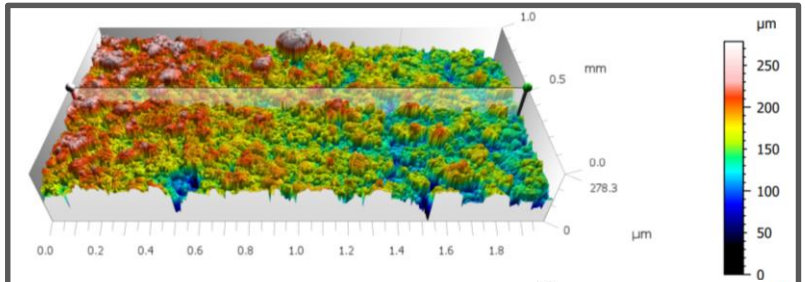


Side

As built

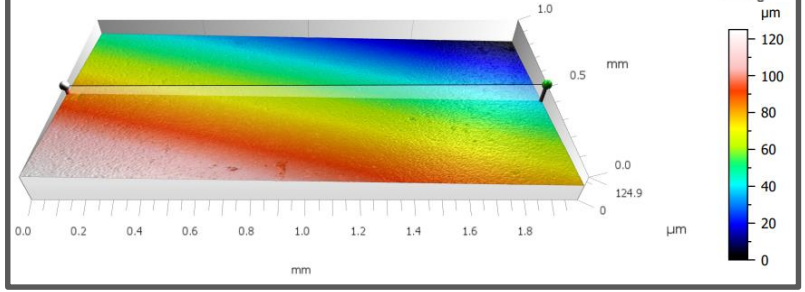


Sa (µm)
10,4
Sz (µm)
157,7



Sa (µm)
18,15
Sz (µm)
248,0

Treated

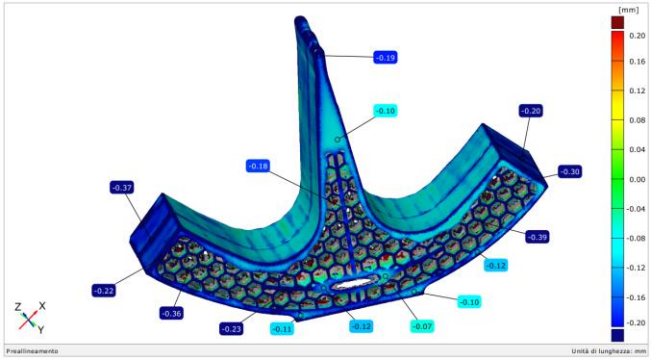


Sa (µm)
2,03
Sz (µm)
25,78

TASK 10.2 - RFQ: SOME RESULTS

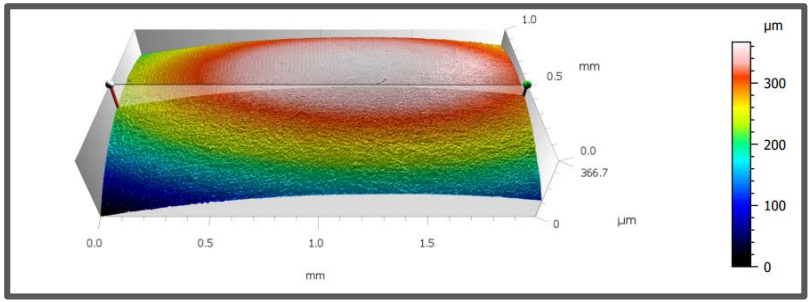
2

Tip

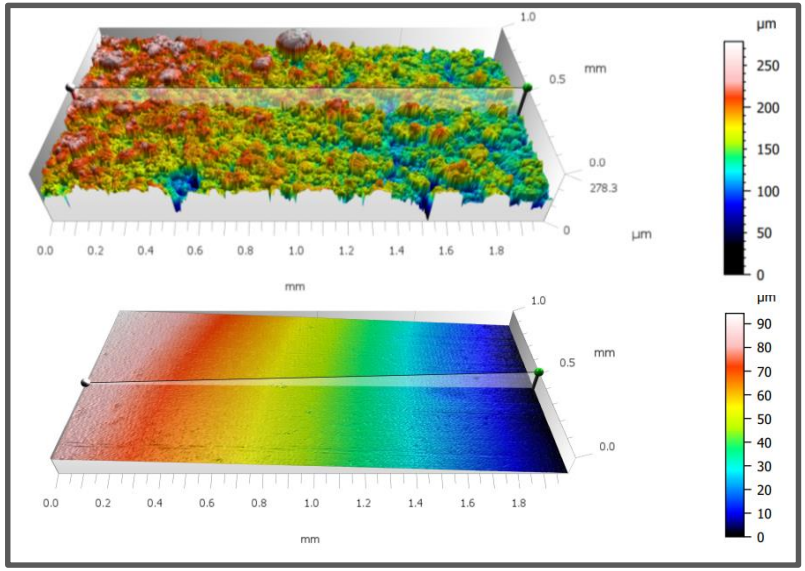


Side

As built



Sa (µm)
12,04
Sz (µm)
117,5



Sa (µm)
18,15
Sz (µm)
248,0

Treated

Sa (µm)
0,84
Sz (µm)
15,20

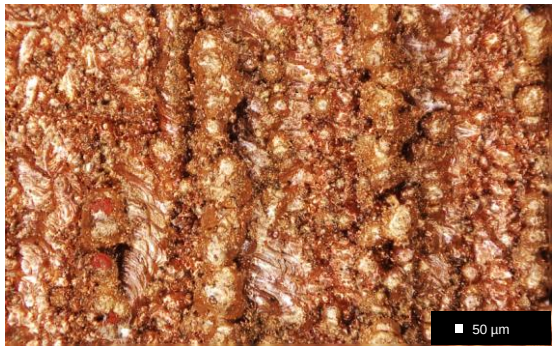
TASK 10.4 - SRF: SOME RESULTS

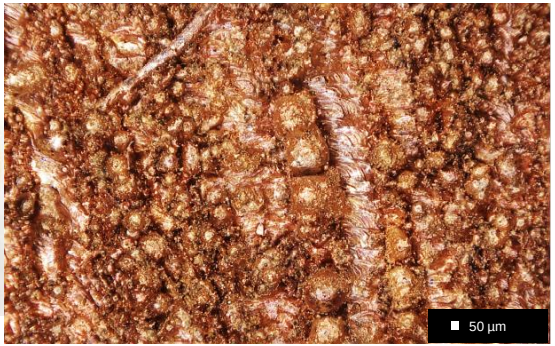
1 Traditional mass finishing process

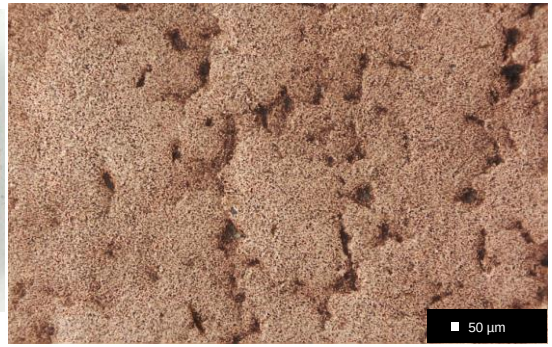
2 Chemically-assisted mass finishing process

As built

Treated







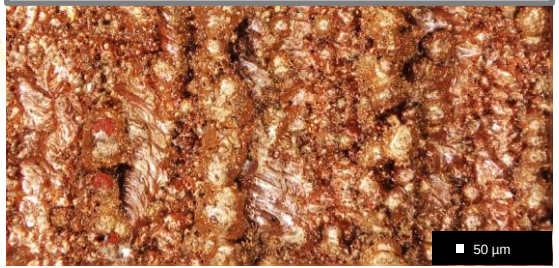
TASK 10.4 - SRF: SOME RESULTS

1 Traditional mass finishing process

2 Chemically-assisted mass finishing process

As built

Ra = 34,29 ± 4,05 µm



Ra = 33,85 ± 4,49 µm

Treated

Ra = 3,86 ± 1,09 µm

Ra = 0,85 ± 0,45 µm

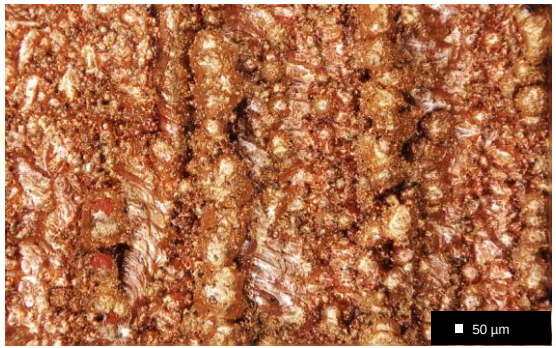
TASK 10.4 - SRF: SOME RESULTS

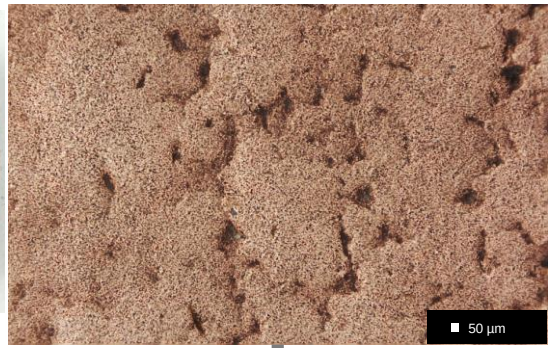
1 Traditional mass finishing process

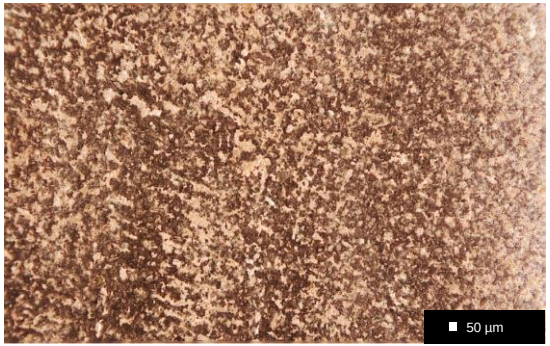
2 Chemically-assisted mass finishing process

As built

Treated







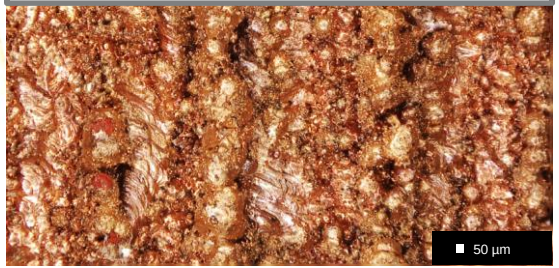
TASK 10.4 - SRF: SOME RESULTS

1 Traditional mass finishing process

2 Chemically-assisted mass finishing process

As built

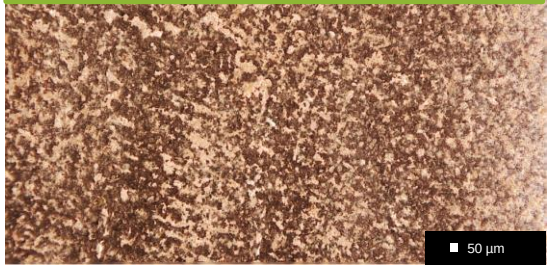
Ra = 34,29 ± 4,05 µm



Treated

Ra = 3,86 ± 1,09 µm

Ra = 0,56 ± 0,06 µm



CONCLUSIONS

Task 10.2: RFQ

Task 10.4: SRF

Mass finishing is a valid technology to significantly decrease roughness of additive manufacturing components

- Roughness target on side surfaces was reached.
- Process improvement to properly finishing also the tip.
- Improvement in mass removal control.
- Setup implementation for treatments on the entire quadrupole.
- Further characterization.

- Roughness target achieved.
- Reproducibility of the process.
- Test on new design SRF cavities.

- Niobium

Thankyou for attention!

MASS FINISHING

SHOT BLASTING

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Ing. Matteo Pozzi

Chemical and Technological LAB – R&D

m.pozzi@rosler.com

Rösler Oberflächentechnik GmbH

Vorstadt 1

D-96190 Untermerzbach

Tel.: +49 9533 / 924-0

Fax.: +49 9533 / 924-300

E-Mail: info@rosler.com