



Know Quality. Choose Progold.

DAMIANO ZITO

DIRECT 3D PRINTING: NEW OPPORTUNITIES FOR JEWELRY PRODUCTION

PRESENTATION STRUCTURE

AT YOUR GLANCE



Introduction

History of production processes and 3D direct precious metal printing overview

Materials

Overview on precious metals alloys already tested and their characteristics compared to casting

Resolution

Reproducible details and thicknesses

Geometries

Type of geometrical strengths

Surface Quality

Roughness, supports' residuals and density

Productivity

Benchmark with casting

Sustainability

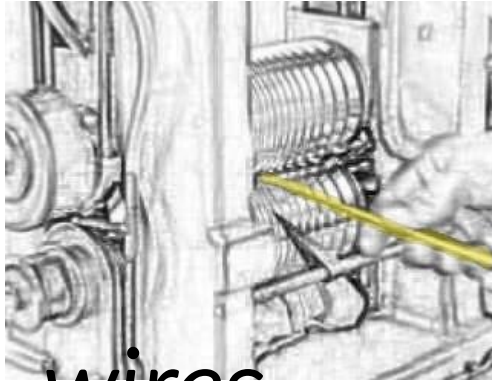
Environmental impact

What to do next

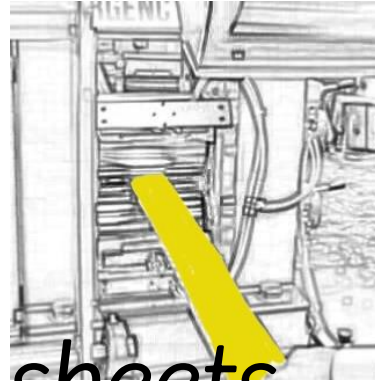
Approach Recommendations

HISTORY

HOW JEWELLERY IS PRODUCED?



wires



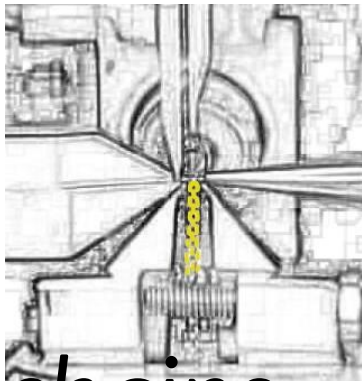
sheets



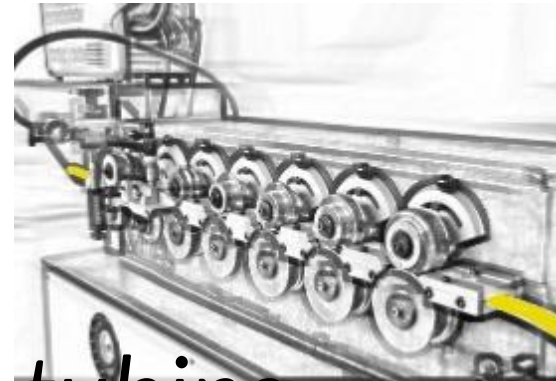
hand made



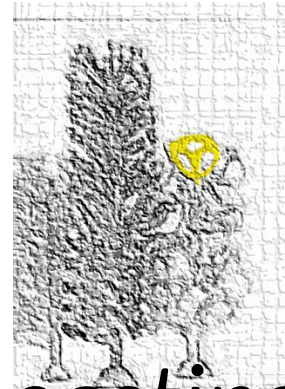
chains



chains



tubing



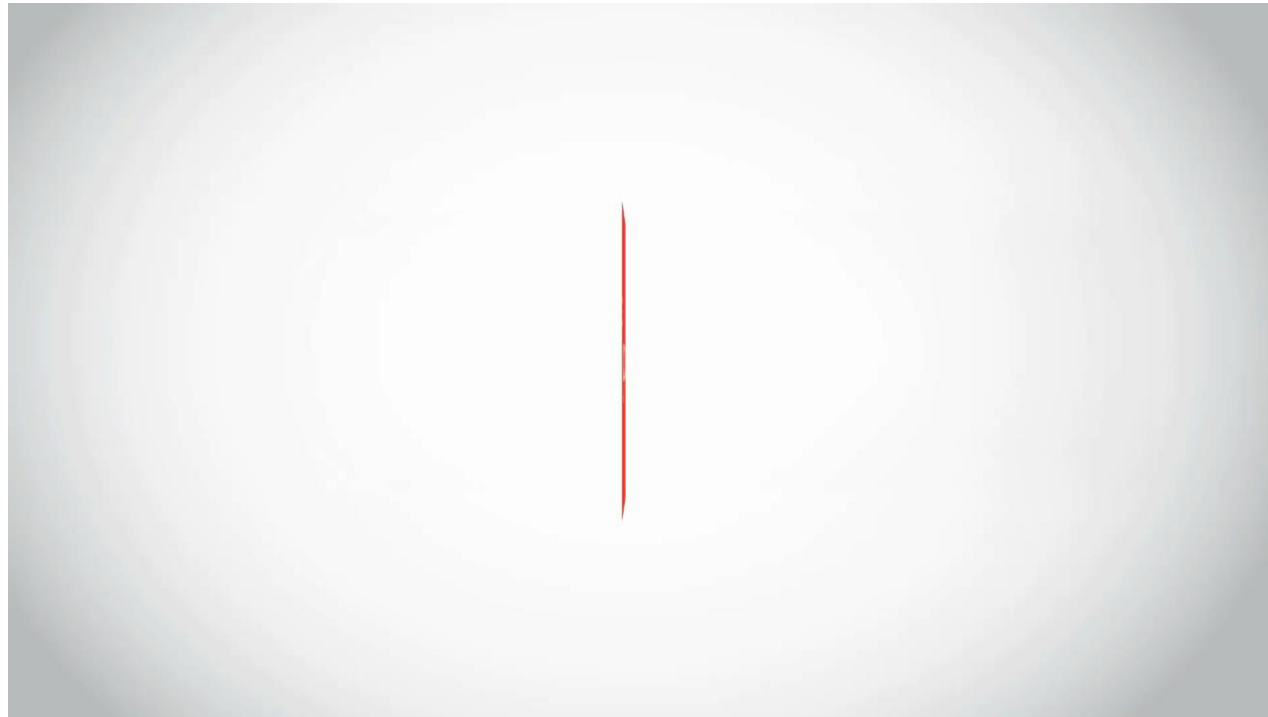
casting



machining

INTRODUCTION

HOW DOES IT WORKS A 3D METAL PRINTER



Type of Process

Powder metallurgy process

Commercials Acronyms

SLM™, SLS™, DMLS™

Technology Type

Layer by Layer

Tested Precious Metals

Tested precious metals: Au, Pt, Pd, Ag

Printers' Producers

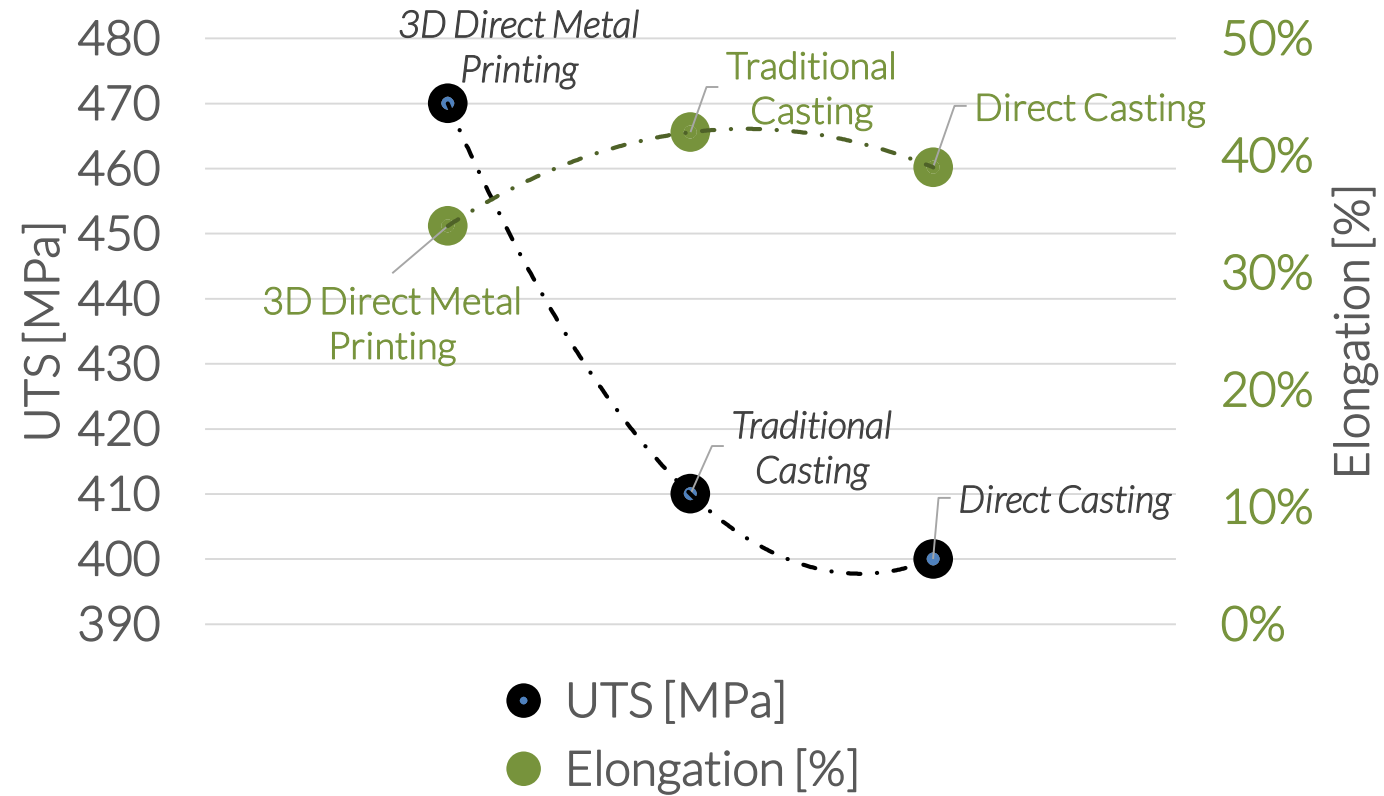
ReaLizer GmbH, EOS GmbH, Concept Laser GmbH, Sisma S.p.A.; Others: Phenix Systems, SLM Solution GmbH, Arcam AB, Renishaw

Precious Metals Powders Producers

Progold S.p.A., Cookson Gold Ltd, Legor Group S.p.A., Hilderbrand CIE SA

MATERIALS

MECHANICAL PROPERTIES BENCHMARK



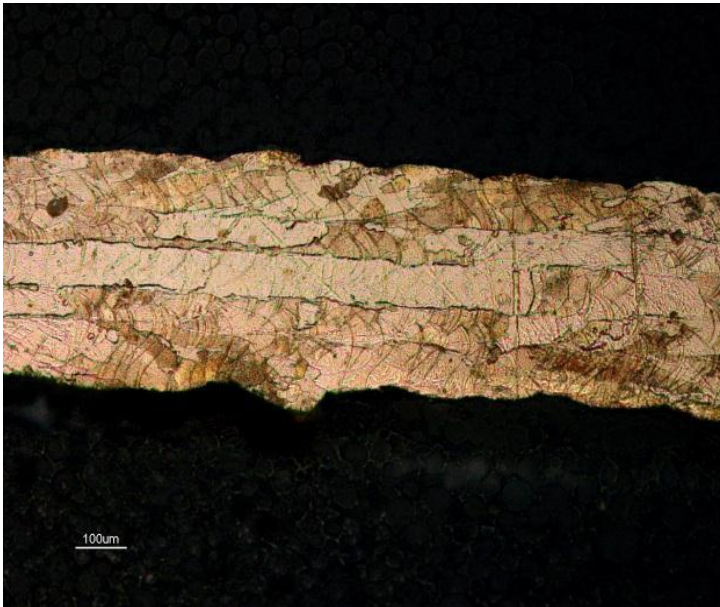
MATERIALS

3N YELLOW GOLD MECHANICAL PROPERTIES

Alloy ID	UTS [MPa]	Elongation [%]	Hardness [HV]
Au3N	>450	>25	<150
Au5N+	>550	>15	<160
AuG2Pd130	>550	>15	<190
Pt950	>670	>20	<180
TiG4	>550	>15	>200

MATERIALS

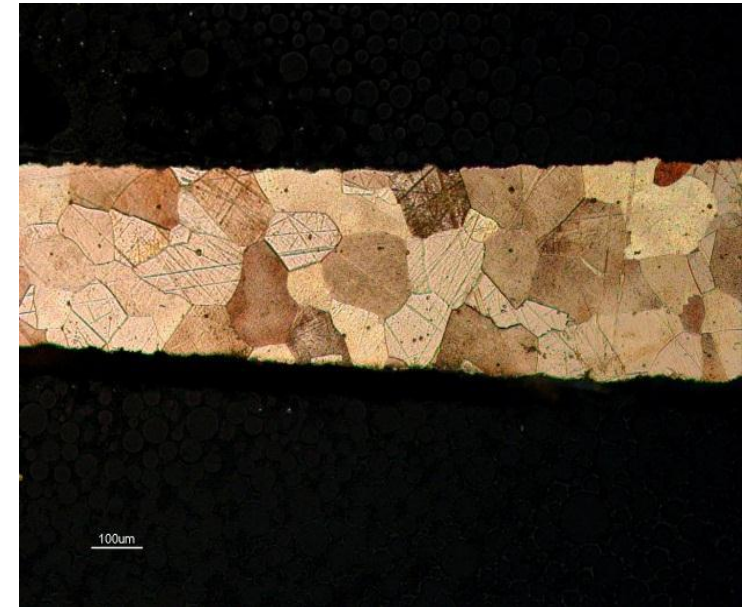
BENCHMARK OF GRAIN SIZE



3D Direct Metal Printing



Traditional Casting



Direct Casting

MATERIALS

HIGH MELTING TEMPERATURE ALLOYS



Platinum 950‰

These alloys has liquidus temperature above 1750°C

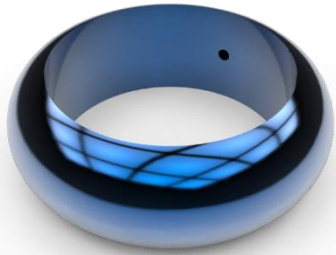


Titanium Grade 4

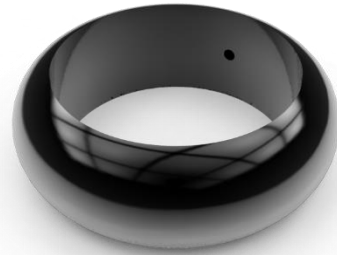
These alloys has liquidus temperature above 1650°C

MATERIALS

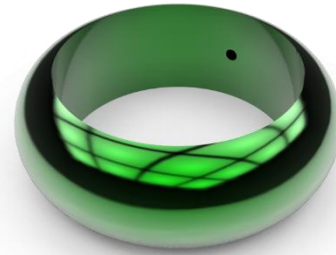
ANODIZED TITANIUM



Blue



Black



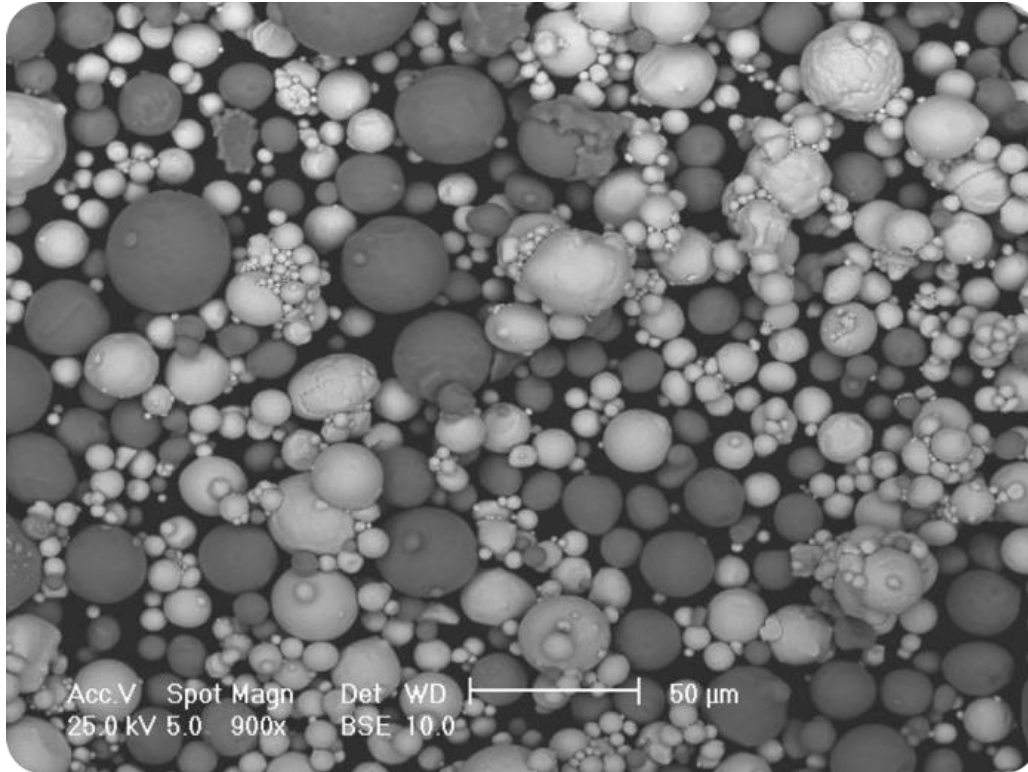
Green



Purple

MATERIALS

ALLOYS OPPORTUNITIES



Composite Alloys

AuTi and AuNb

Colour

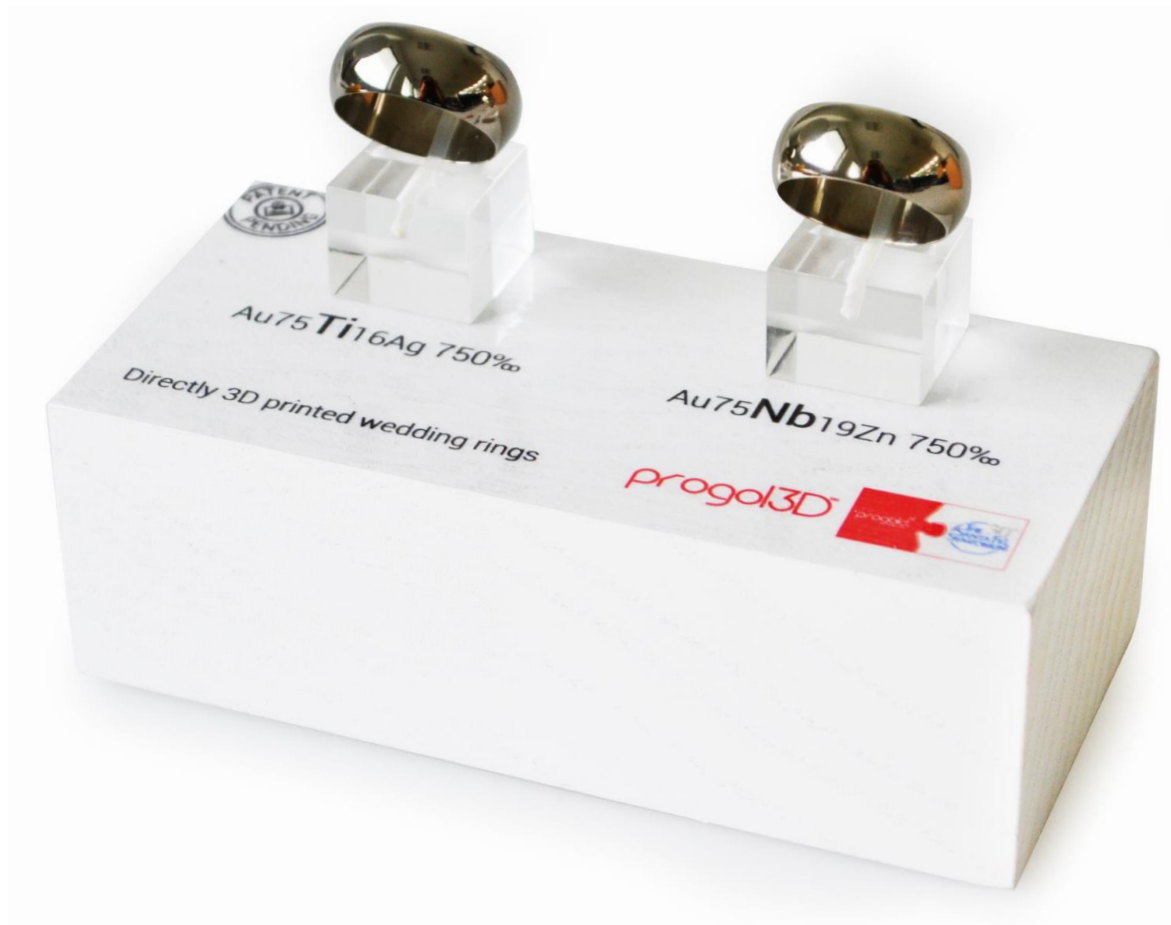
Super White YI < 15

Density

30% less than standard Pd white gold

MATERIALS

ALLOYS OPPORTUNITIES



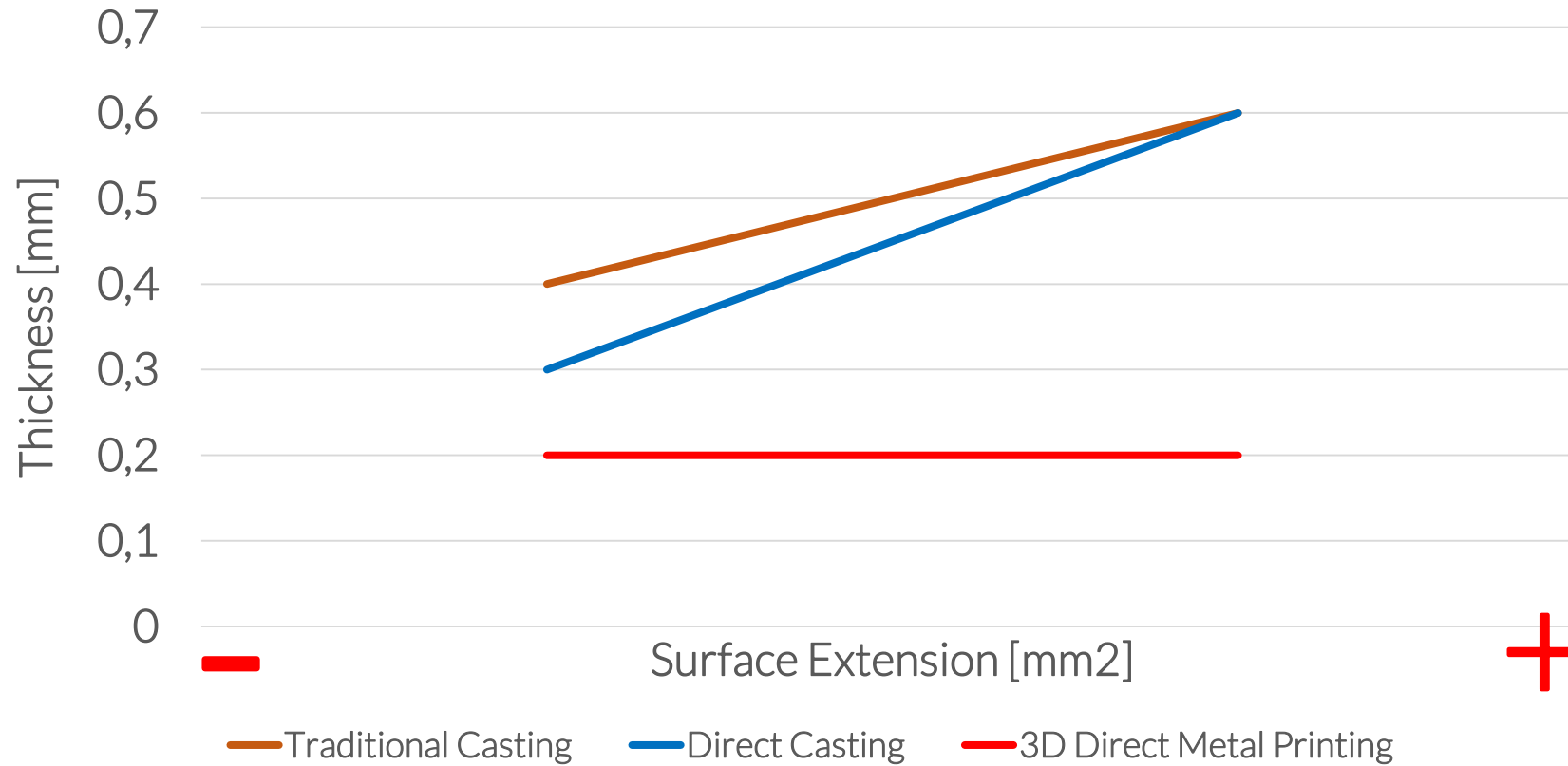
RESOLUTION

DPI (DOTS PER INCH)

Alloy ID	XY[DPI]	Z [DPI]
Au3N	120	1200
Au5N+	120	1200
AuG2Pd130	150	1200
Pt950	170	1200
TiG4	120	500

RESOLUTION

THICKNESSES VS. SURFACE EXTENSION

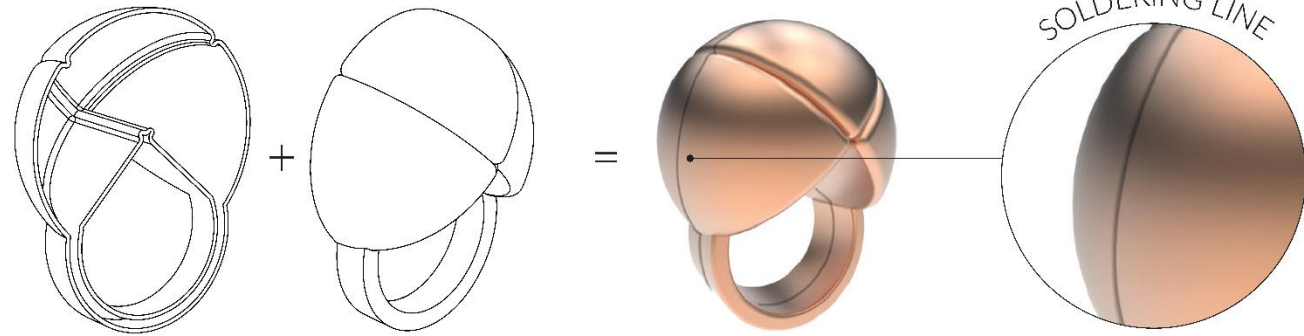


GEOMETRIES

MONOLITHIC JEWELS

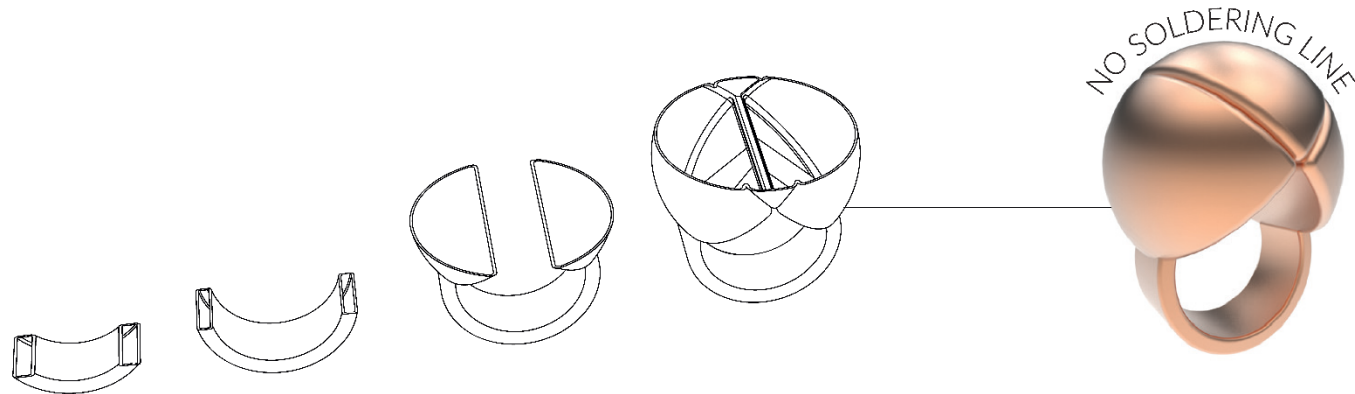
Casting

To hollow rings the cast need to be assembled



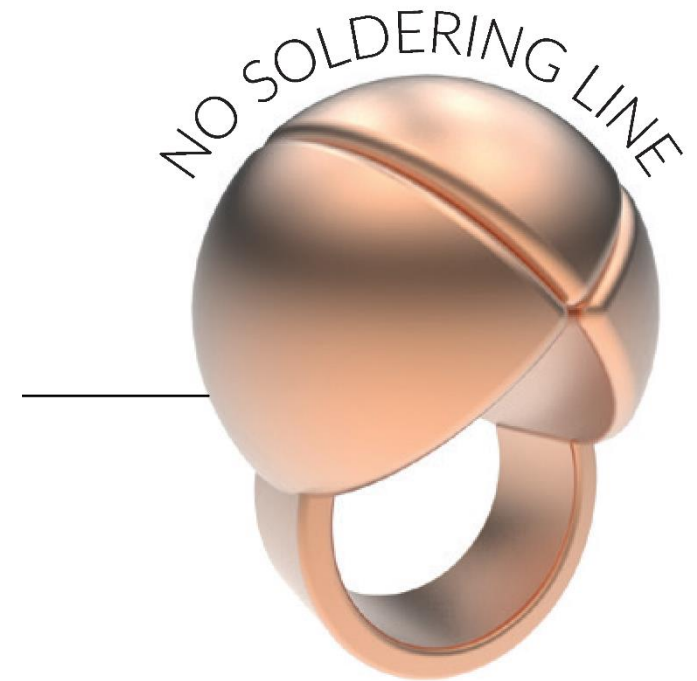
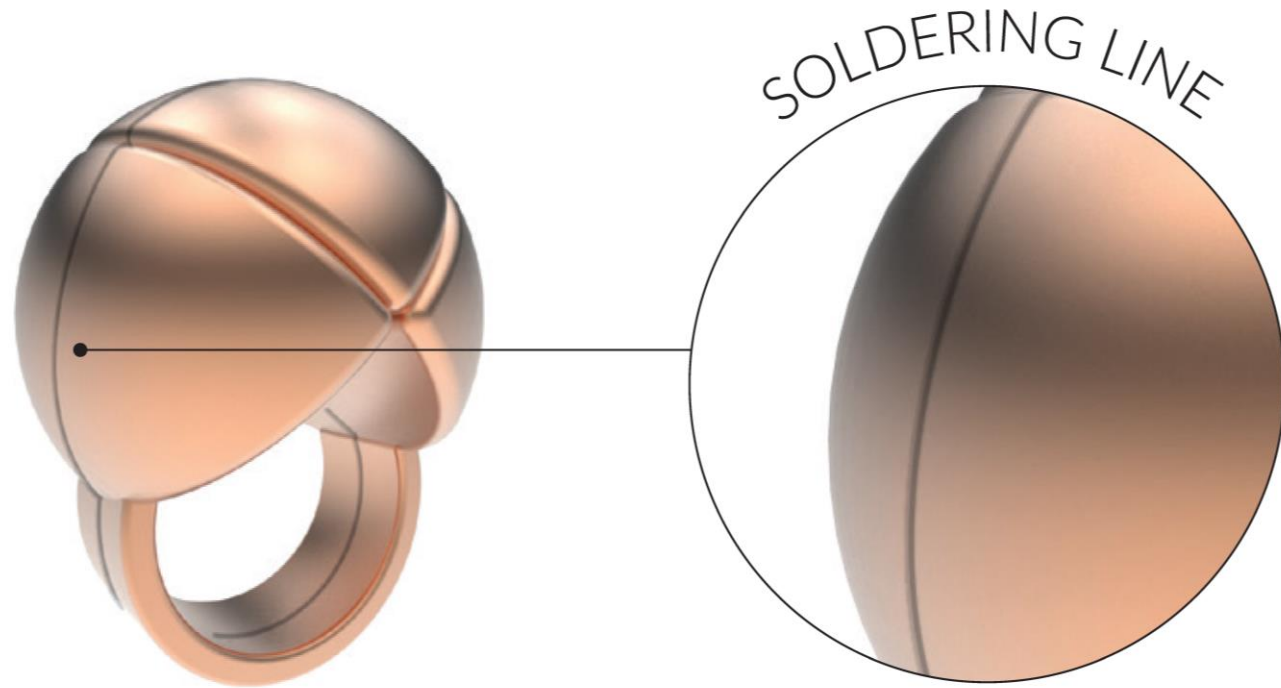
3D direct metal printing

To hollow the ring it can be printed monolithic



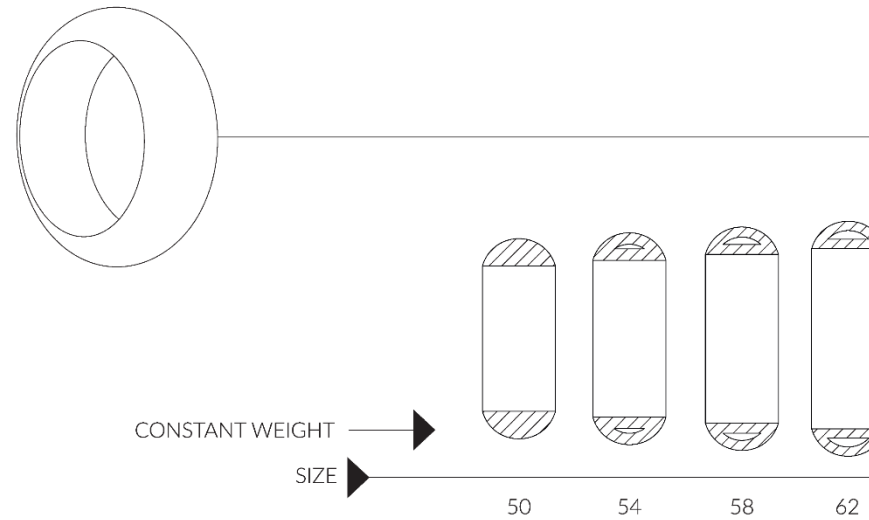
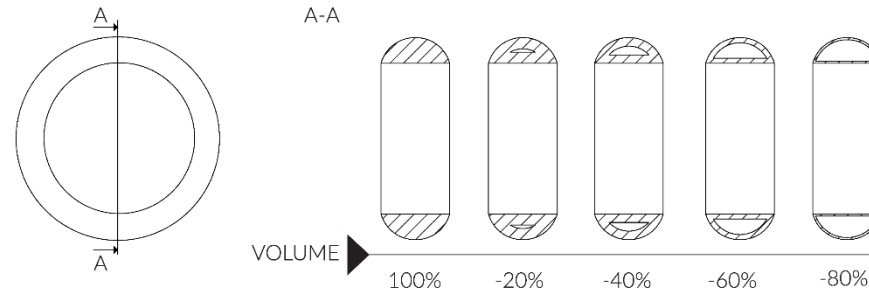
GEOMETRIES

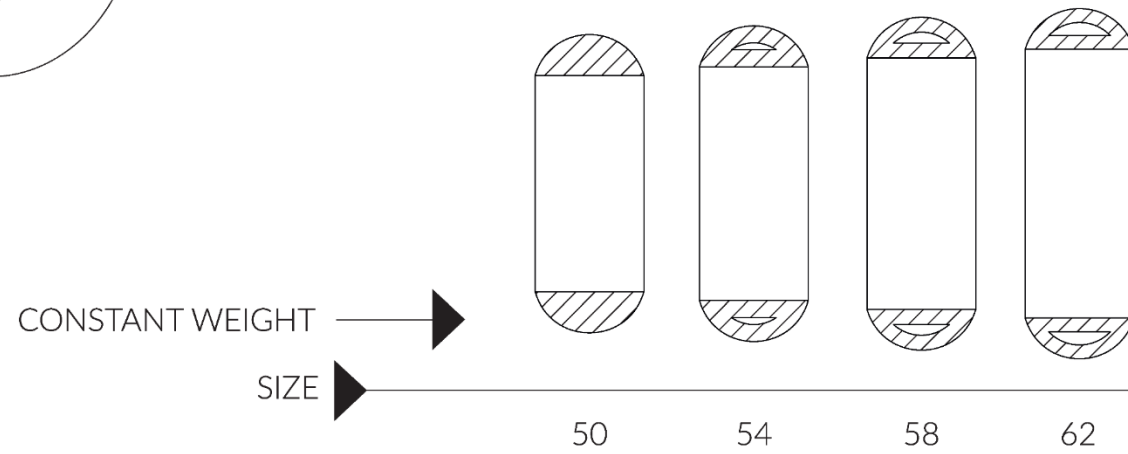
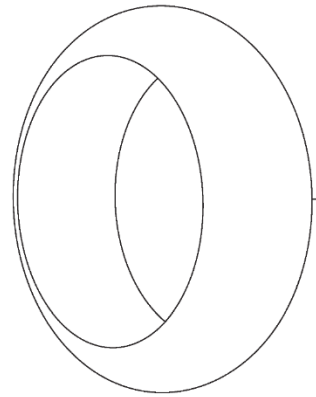
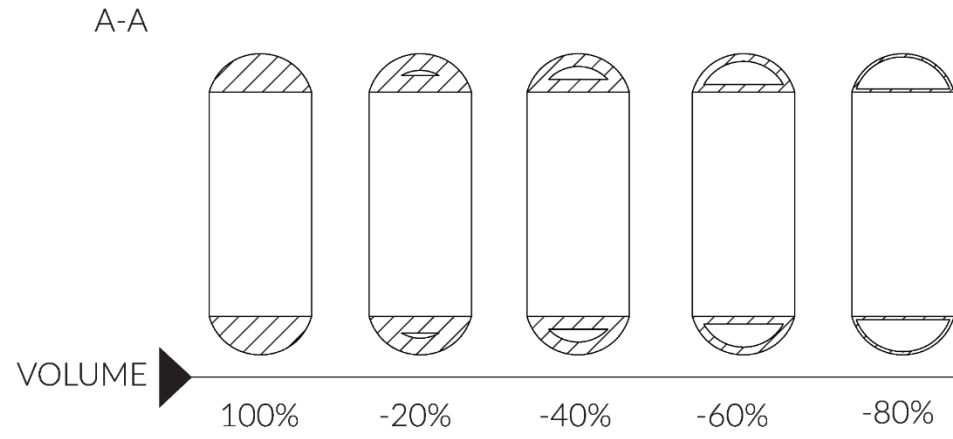
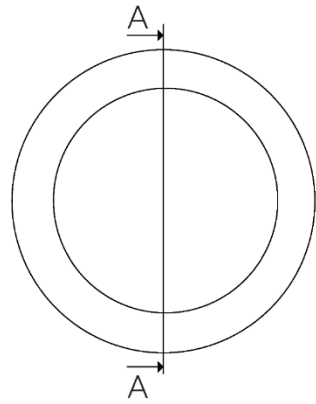
HOLLOW JEWELS



GEOMETRIES

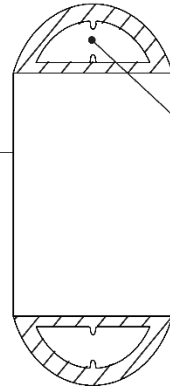
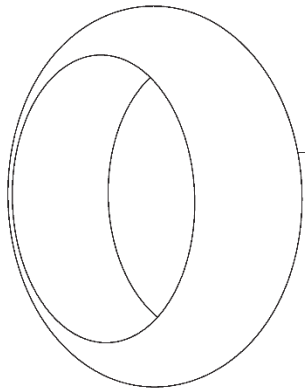
HOLLOW WEARABLE & SMART HOLLOW KSIZE





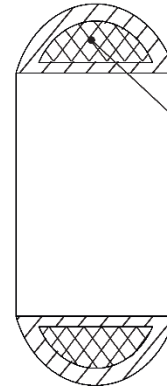
GEOMETRIES

REINFORCEMENT RIB & LATTICE STRUCTURE



1. REINFORCING RIB

3D direct metal printing allows to design an internal reinforcing rib granting the proper stiffness to large and thin surfaces, in order to avoid any anti-aesthetical damage due to accidental hits or bumps. This is also the less weight invasive solution to enforce a hollow volume.

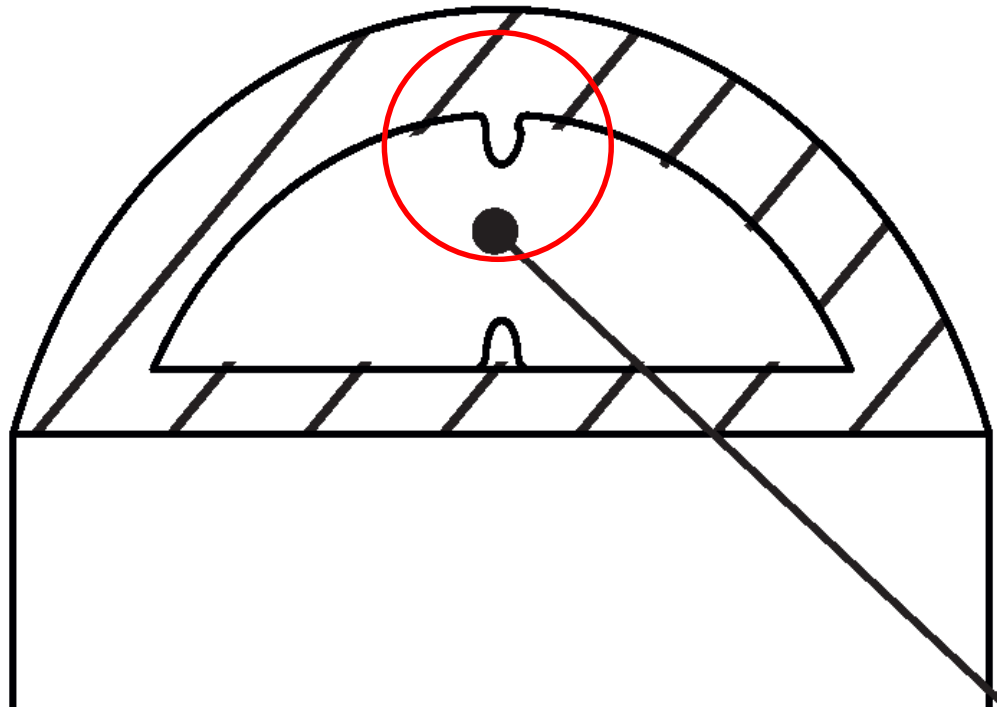


2. LATTICE STRUCTURE SUPPORT

An additional opportunity is to build an internal support system, so called lattice structure, which enforces the jewel as well as it prevents the piece from sounding as hollow. This option will be at the end a bit heavier than the reinforcing rib previously described.

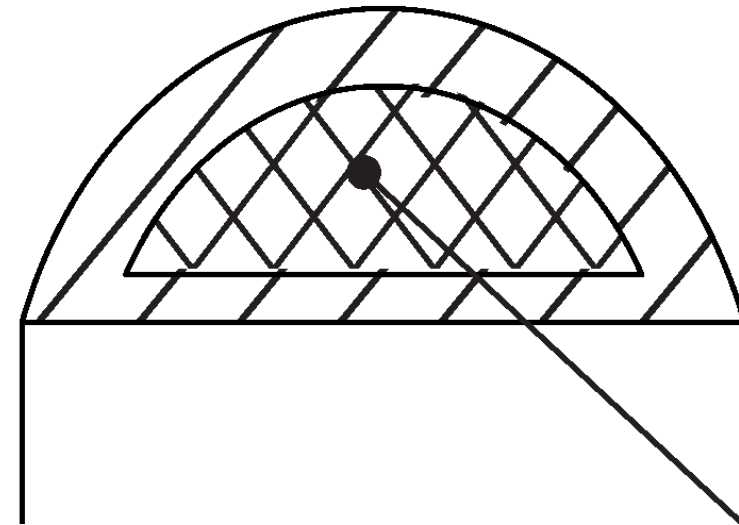
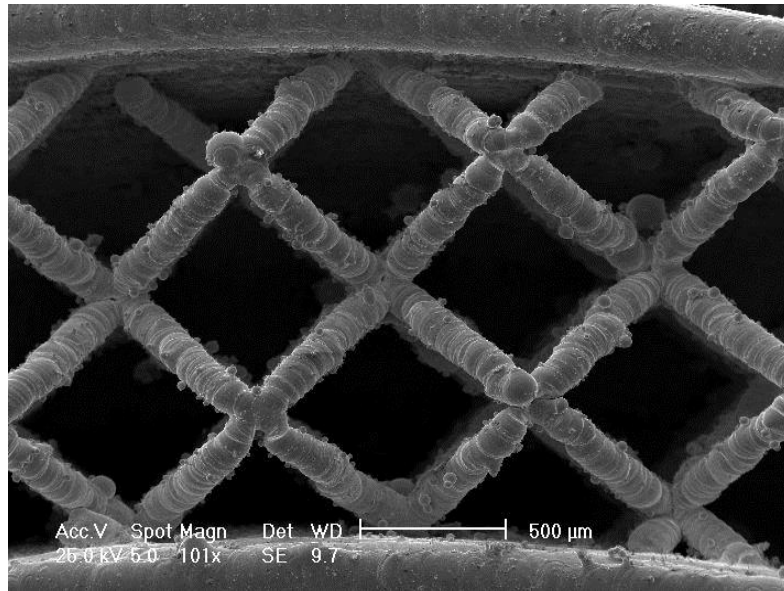
GEOMETRIES

REINFORCEMENT RIB & LATTICE STRUCTURE



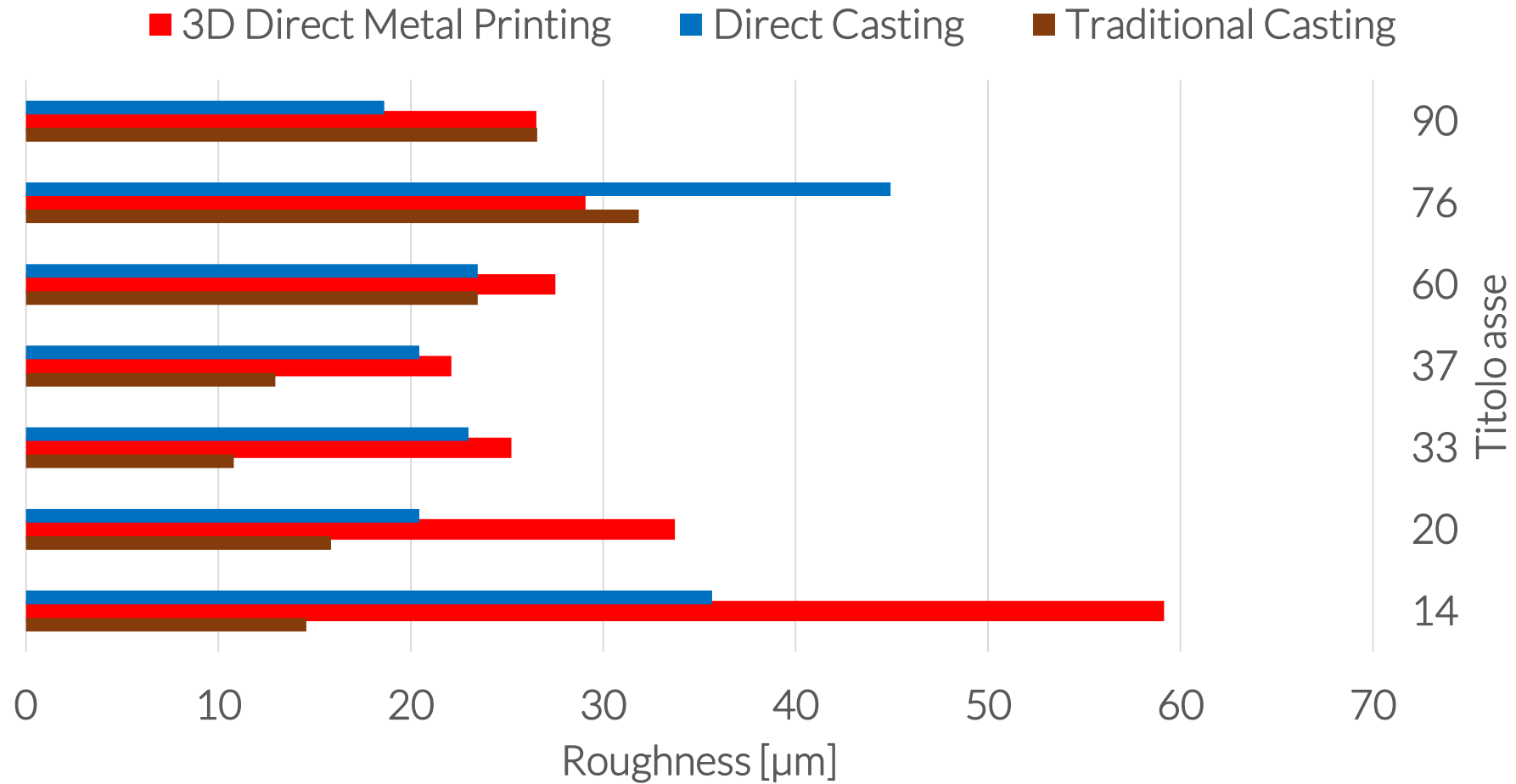
GEOMETRIES

REINFORCEMENT RIB & LATTICE STRUCTURE



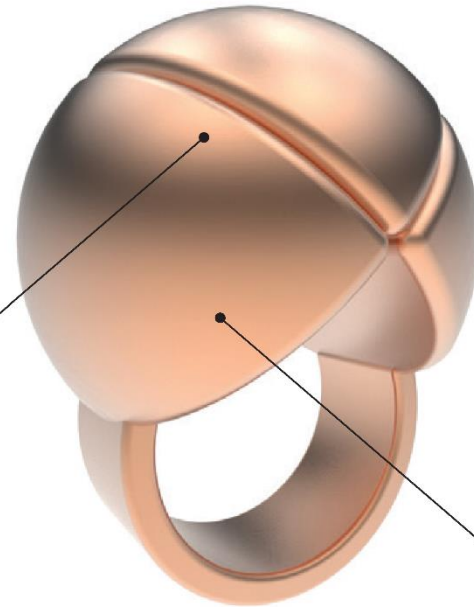
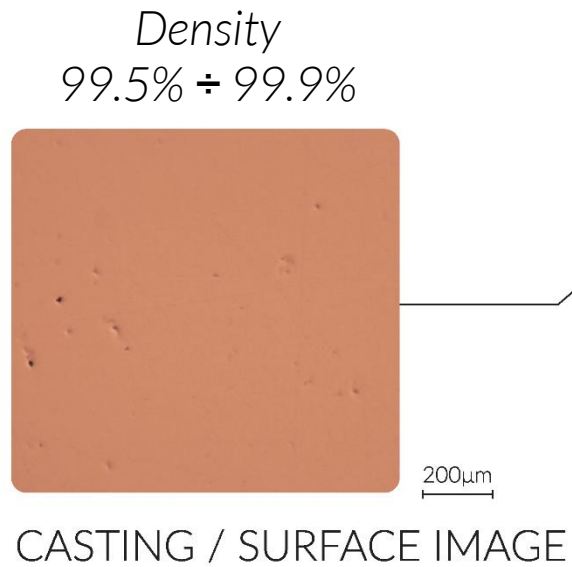
SURFACE QUALITY

ROUGHNESS [R_t] BENCHMARK



SURFACE QUALITY

DENSITY BENCHMARK



SURFACE QUALITY

SUPPORTS RESIDUALS



1.

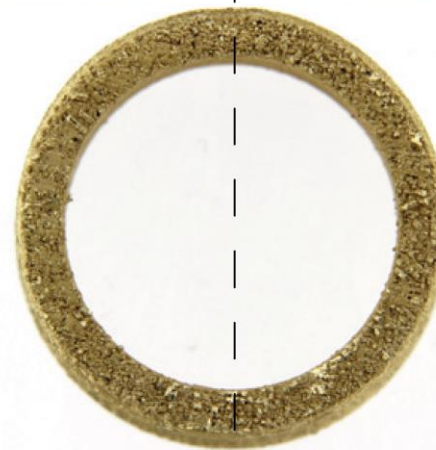
2.

3.

4.

5.

6.



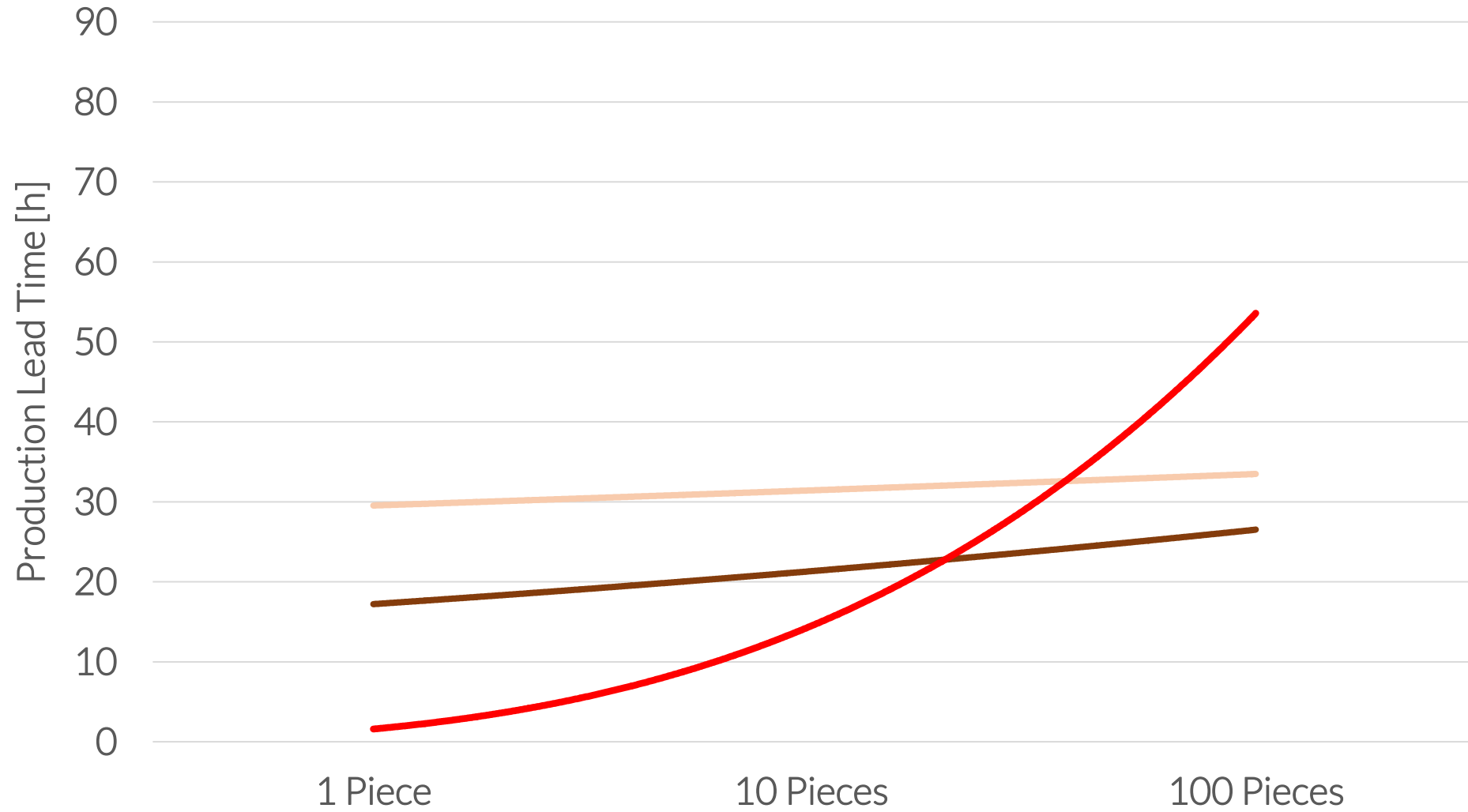
SURFACE QUALITY

SUPPORTS RESIDUALS



PRODUCTION

PRODUCTION LEAD TIME



PRODUCTION

PRODUCTION CAPACITY BENCHMARK

Process	Production Capacity [kg/day]
Traditional Casting	3.75
Direct Casting	2.20
3D Direct Metal Printing	0.35

SUSTAINABILITY

CARBON FOOTPRINT

