


The logo for 3D DAG features the text '3D DAG' in a bold, sans-serif font. The '3D' is rendered in red, while 'DAG' is in a light grey. The text is positioned to the left of a white-outlined square. A solid white square is attached to the top-right corner of the white outline, extending to the right.

3D DAG

May 12th, 2022
Dr. Marek Krehel

Transfer and upscaling of micro and nanostructures to moulding tools and roll to roll processes, general overview.



Transfer and upscaling of micro and nanostructures to moulding tools and roll to roll processes, general overview

➔ ➔ **STRUCTURE TRANSFER** ➔ ➔

**STRUCTURE
DEVELOPMENT**

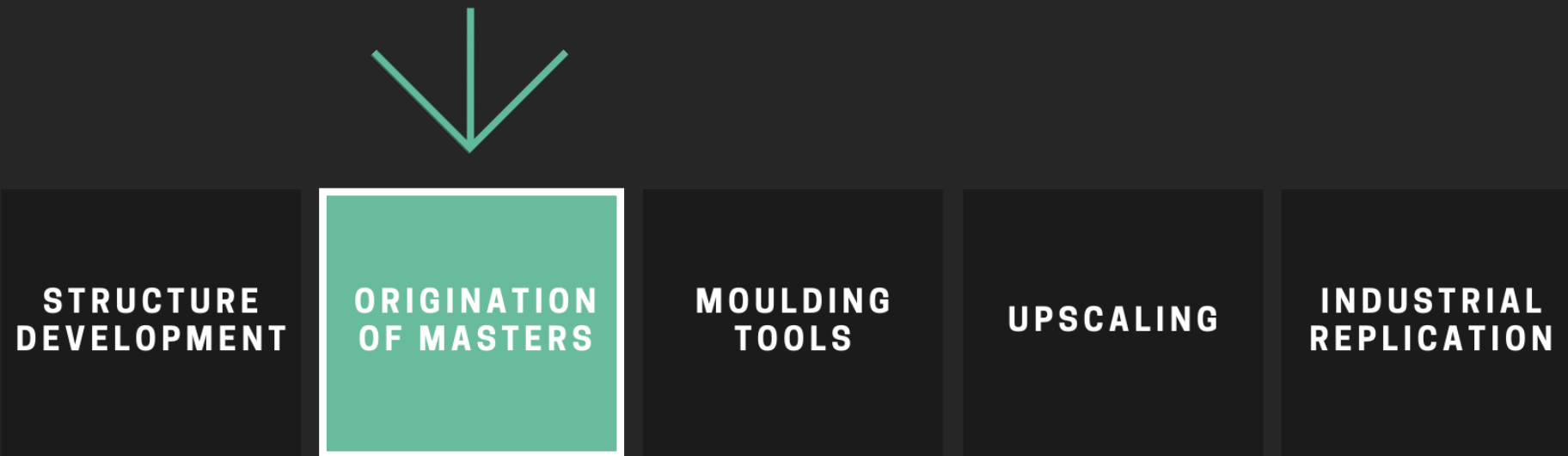
**ORINATION
OF MASTERS**



**MOULDING
TOOLS**

UPSCALING

**INDUSTRIAL
REPLICATION**



For each type of structure, there is an optimal mastering process. Each technology has advantages and disadvantages that will affect the future processes, as well as structure fidelity.

- Lithography
- E beam
- Diamond Turning
- Laser Ablation
- Direct Laser Writing
- 3D Printing
- ...



BASE MATERIALS

Metals

- BRASS
- COPPER
- STAINLESS STEEL
- TITANIUM
- BRONZE
- NICKEL

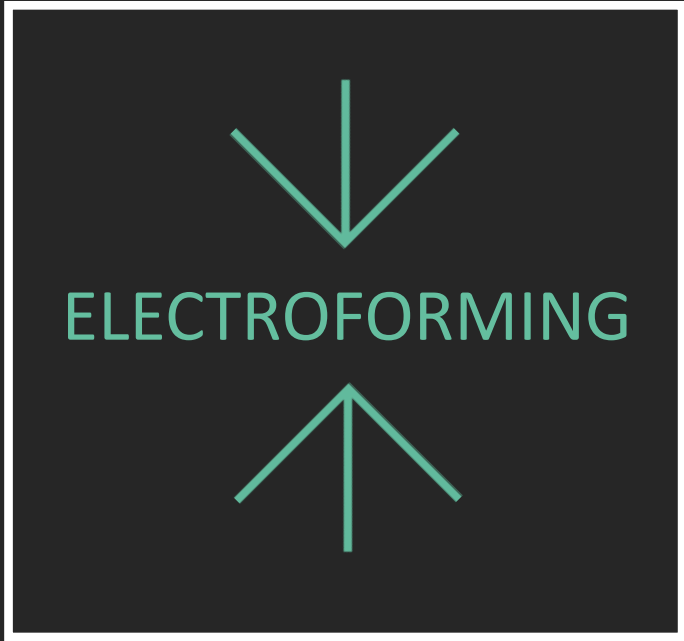
Organic/ Inorganic

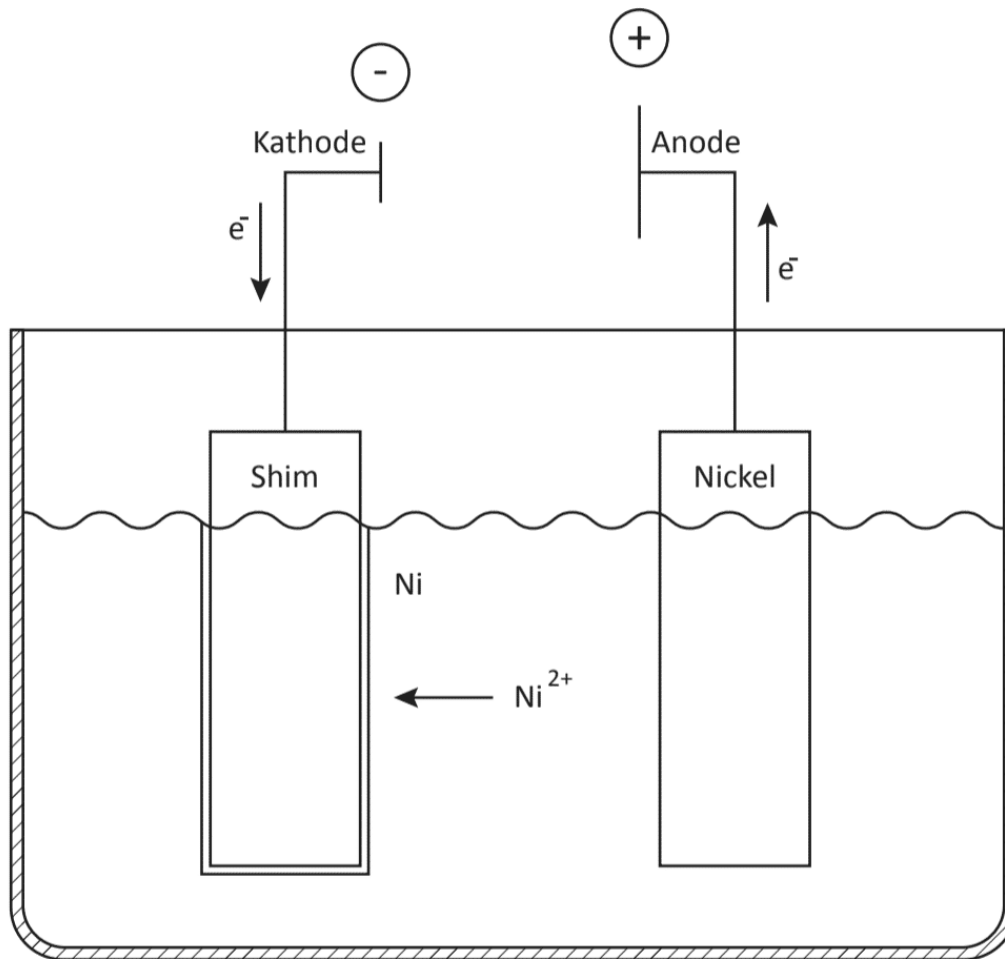
- PMMA
- PC, PVC, PS
- UV-CURED RESIN
- PHOTORESIST
- SOL-GELS
- EPOXIES

Non-Metals

- GLASS
- QUARTZ
- FUSED SILICA
- CERAMICS
- SILICON

The core speciality of 3D AG is the electroforming of shims from nearly every base material.





ELECTROFORMING VS ELECTROPLATING

- Electrodeposition process
- Deposition of metal onto a conductive object
- Anode and a cathode in electrolytic bath
- Direct current of electricity
- Plating of metal ions onto

THE DIFFERENCE

Electroplating > Deposition of metal layer

Electroforming > Creation of new piece by separation



NICKEL SHIM

=

TOOL

Master template

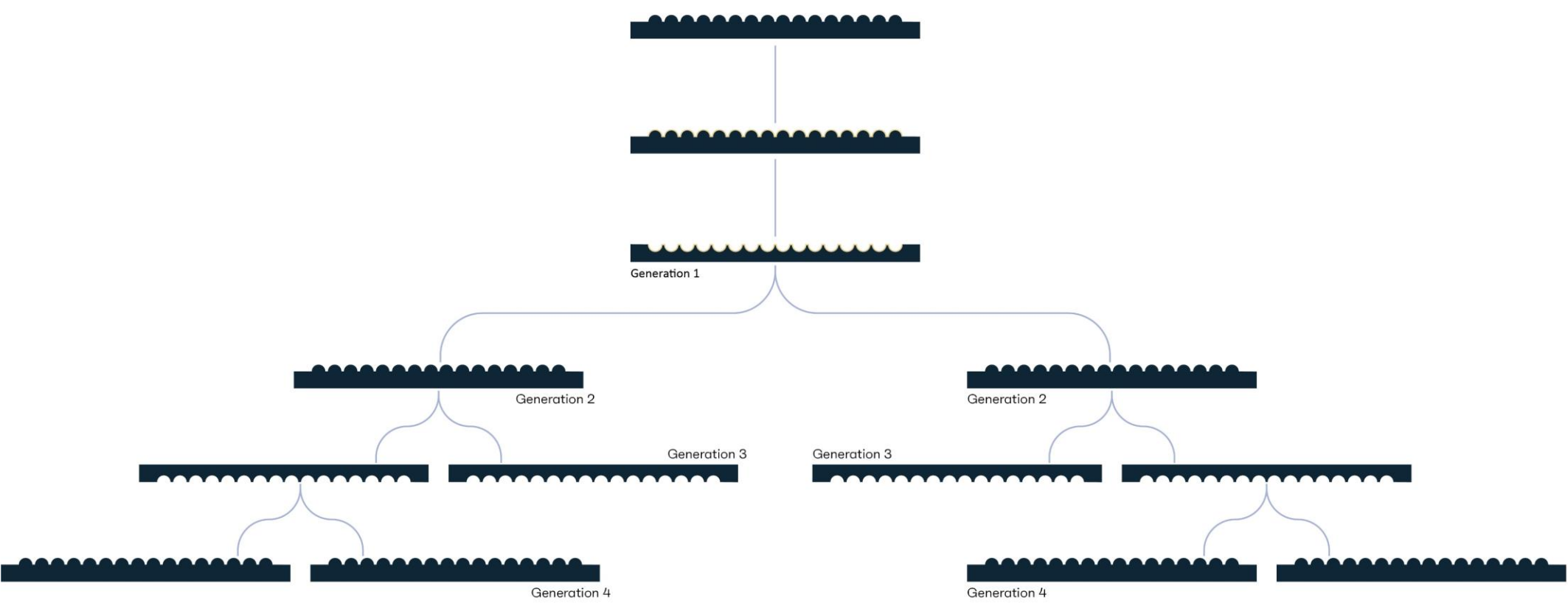
Master template with silver (Ag) seed layer

Ag-Ni master shim

Ni submaster shim

Ni sub- submaster shim

Production shim



SHIM FAMILIES

Product: Master, submaster and production shims

Material: Silver nickel alloy and/or nickel

Thickness: From a few μm to several cm

Add-ons: Register marks

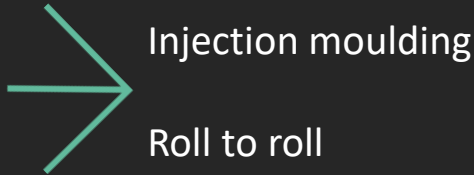


BENEFITS

Shims are durable nickel molds that are electroformed to replicate existing micro & nano structures from a master.



- Cost effectiveness
- High quality material
- High fidelity of structure
- Minimal shrinkage
- High endurance
- Durability yet flexibility
- Long lifetime



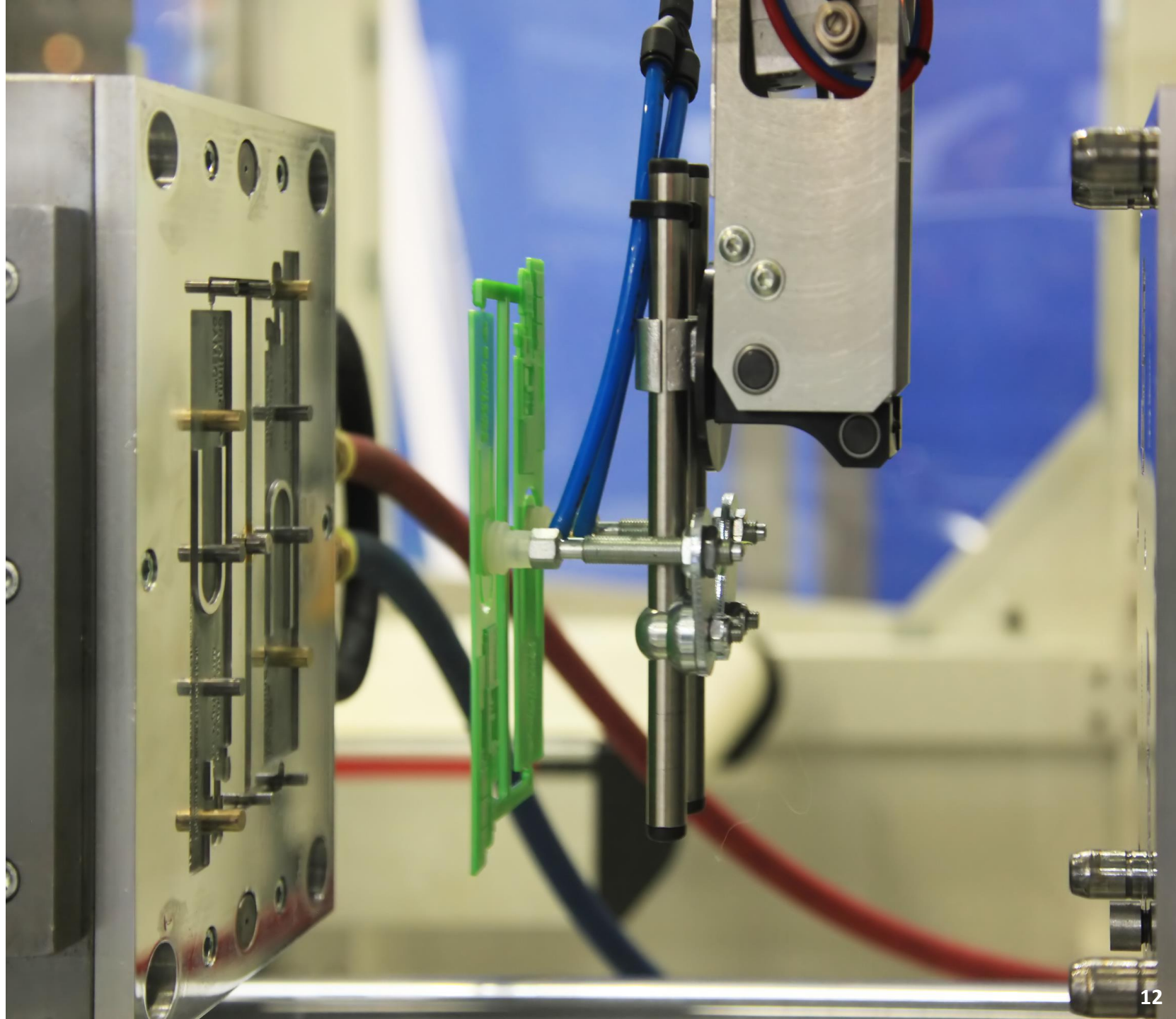
INJECTION MOULDING TOOLS

Usually quite thick and burly

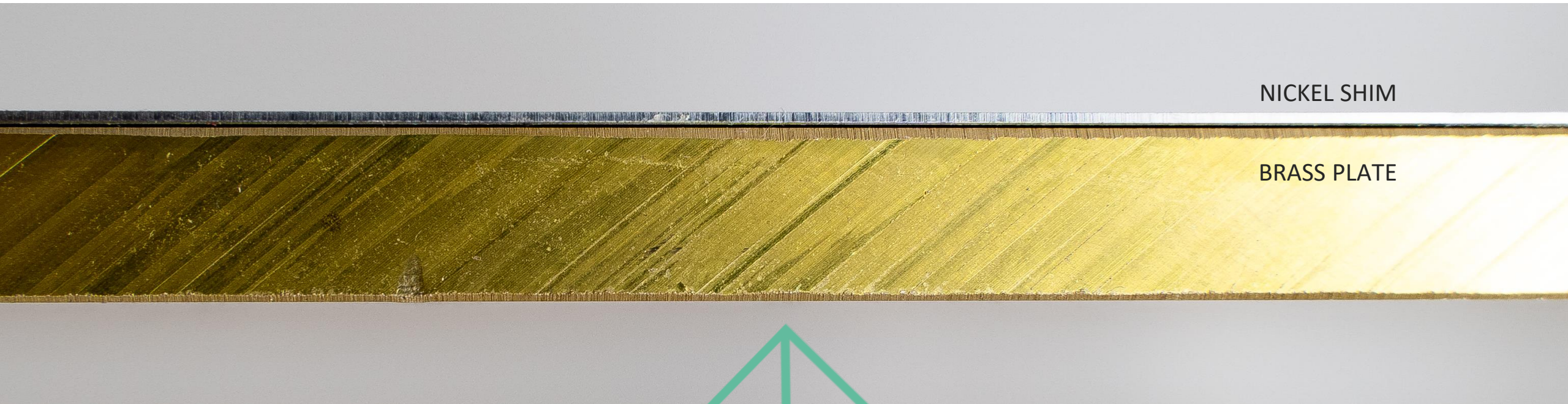
Diamond turning a new master

Electroforming approach:

- Thick shims and laser cut
- Welding shims to an insert
- Attachment of thinner shims



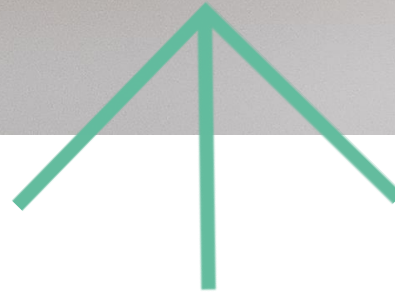
ADHESIVE LAYERS



NICKEL SHIM

BRASS PLATE

Low temperature stability
Large size

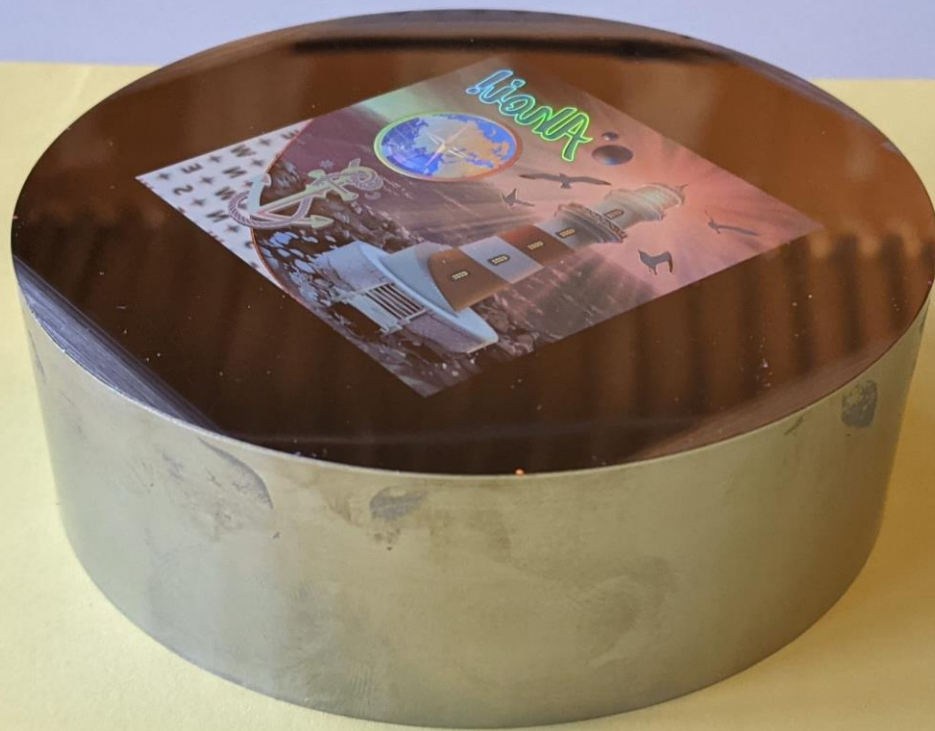


WELDING SHIMS

NICKEL SHIM

WELD LINE

METAL BASE



Size Limitation

R2R/ ROLL TO ROLL

Thermal and UV

Tools are usually:

- Thin
- Flexible
- Large



SLEEVES

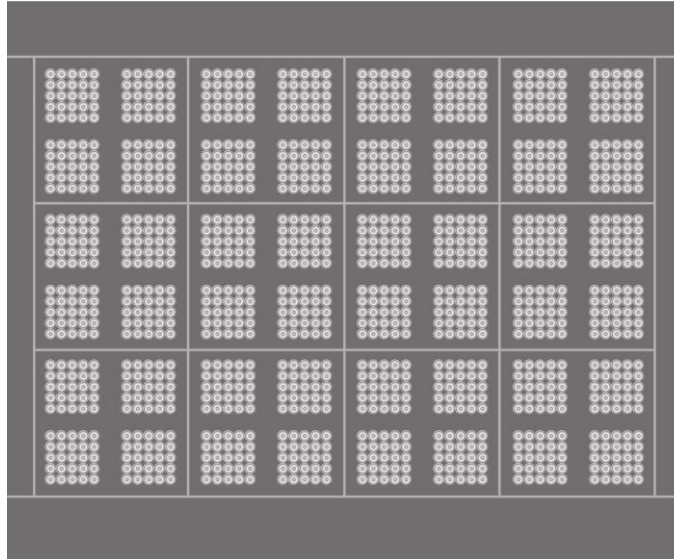
Originating large masters

Originating small master and replicating them:

- Multiple shims
- Step and repeat nanoimprinting

EXAMPLE:
Small sleeve, ID approx. 65 mm
Large sleeves, ID approx. 500 mm

WELDING



Standard seam 120 μm

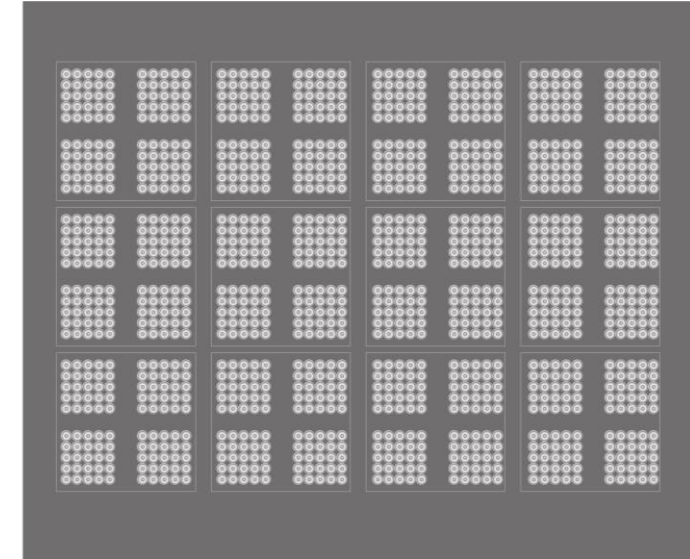
Single-cell no limit

Max welding length 2000 mm

Cutting accuracy, repeatability and alignment accuracy $<10 \mu\text{m}$

Tension, seam may be an issue

RECOMBINATION



Seam depending on the structure

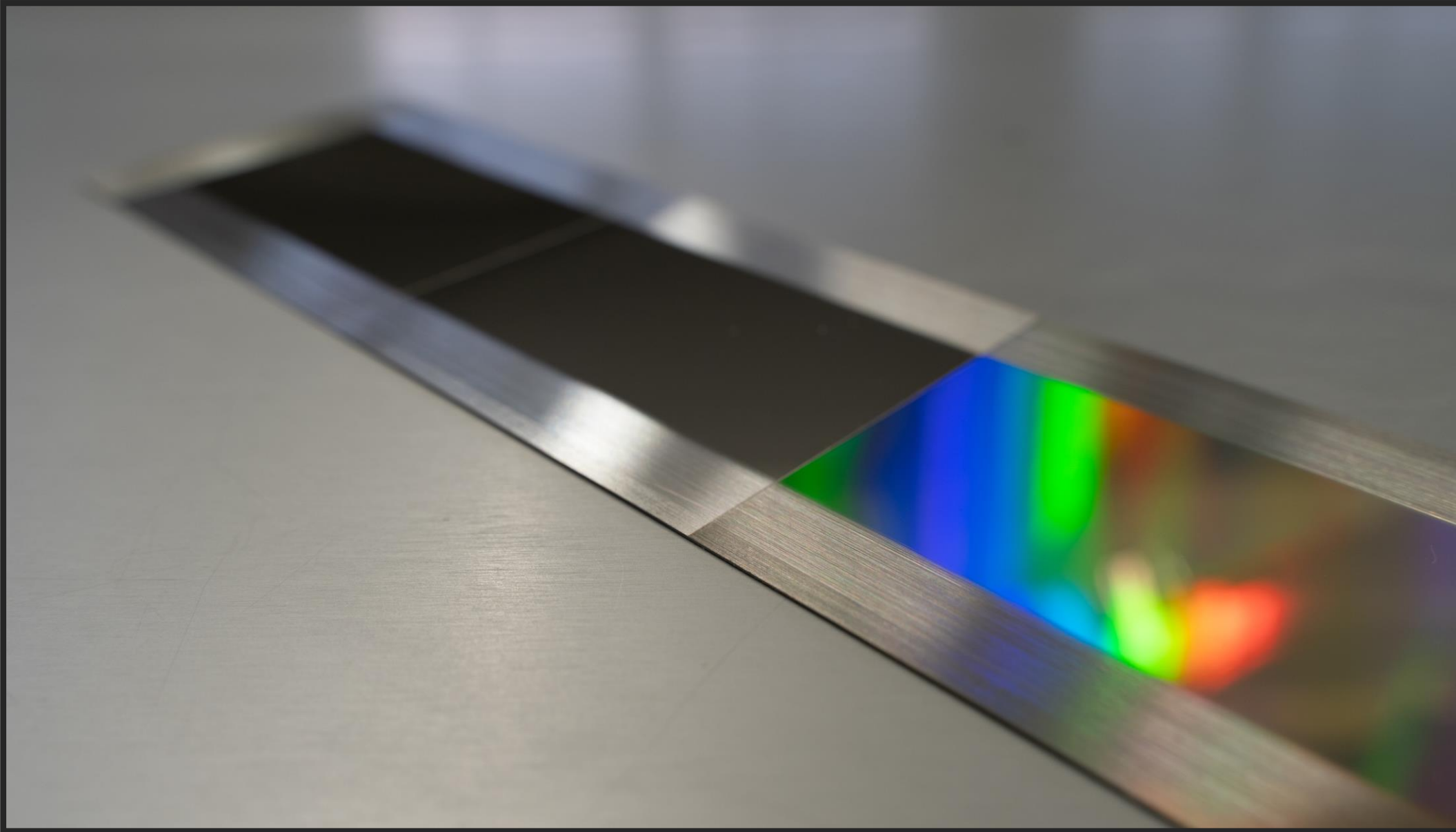
Single-cell size 250 mm x 200 mm

Active area 1300 mm x 1500 mm

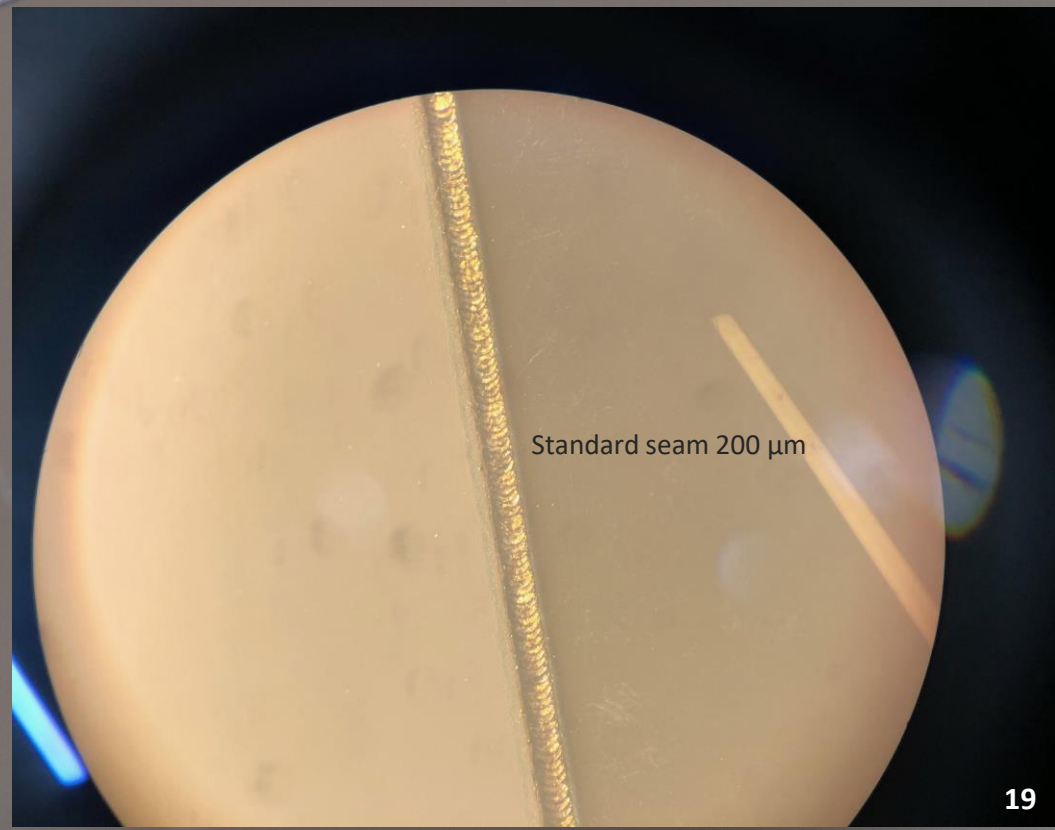
X,Y accuracies of $-/+5\mu\text{m}$

Not every structure works well
Structure shrinkage

WELDING



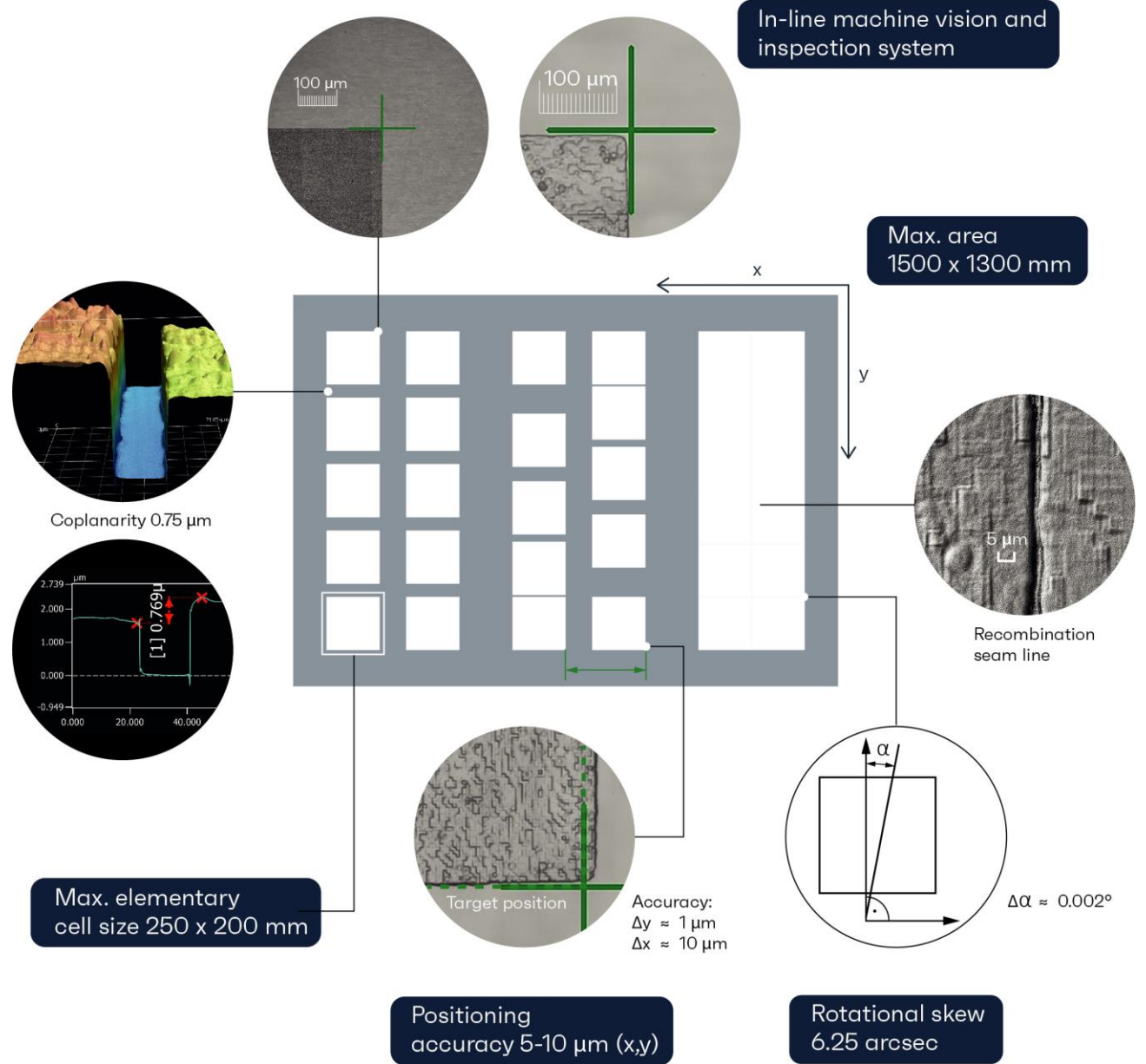
WELDING SEAM



Standard seam 200 μm

UV step and repeat nanoimprinting

HUGO



Max. elementary cell size 250 x 200 mm

Positioning accuracy 5-10 μm (x,y)

Rotational skew 6.25 arcsec

No technology is perfect

Often complement each other

Competition vs Partnership



ABOUT US

Founded 1989
Family owned and independent
Swiss made technology
Customer centred solution provider



**We are a solution provider supporting you to bring
your structure from “lab to industry”.**

Let's create your benefit.



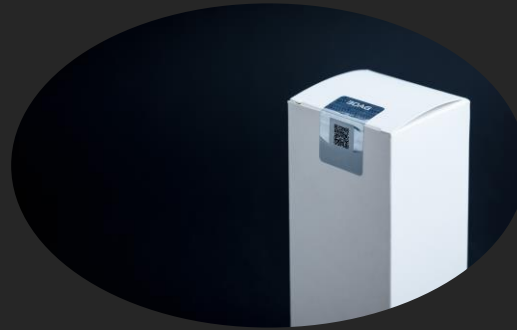
BUSINESS UNITS

A general overview of services and products for each of 3D AG's business units



HIGH SECURITY

Banknotes
Tax Stamps
Precious Metals



BRAND PROTECTION

Security Labels
Digitalization
Blockchain



MICRO & NANOTECHNOLOGY

Origination
Shims
Recombination



VISUAL ENHANCEMENT

Rainbow
Holographic Patterns
Fresnel Lens

THANK YOU

Questions?

Contact **3DAG**

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3dag.ch

THIN SHIMS	THICK SHIMS
STANDARD RANGE 40 µm – 190 µm	RANGE 200 µm – 1500 µm
MINIMUM THICKNESS 40 µm	MAXIMUM THICKNESS 5 mm *
POSSIBLE USAGE <ul style="list-style-type: none"> ▪ Formed onto cylinder ▪ Welded to sleeve ▪ Used as consumable 	POSSIBLE USAGE <ul style="list-style-type: none"> ▪ Stamper ▪ Insert ▪ Injection mold
Flexible and shapeable	Rigid and safe
Prone to dents & ticks	Secure in handling
Attention with deep structure	Possible backside grinding

