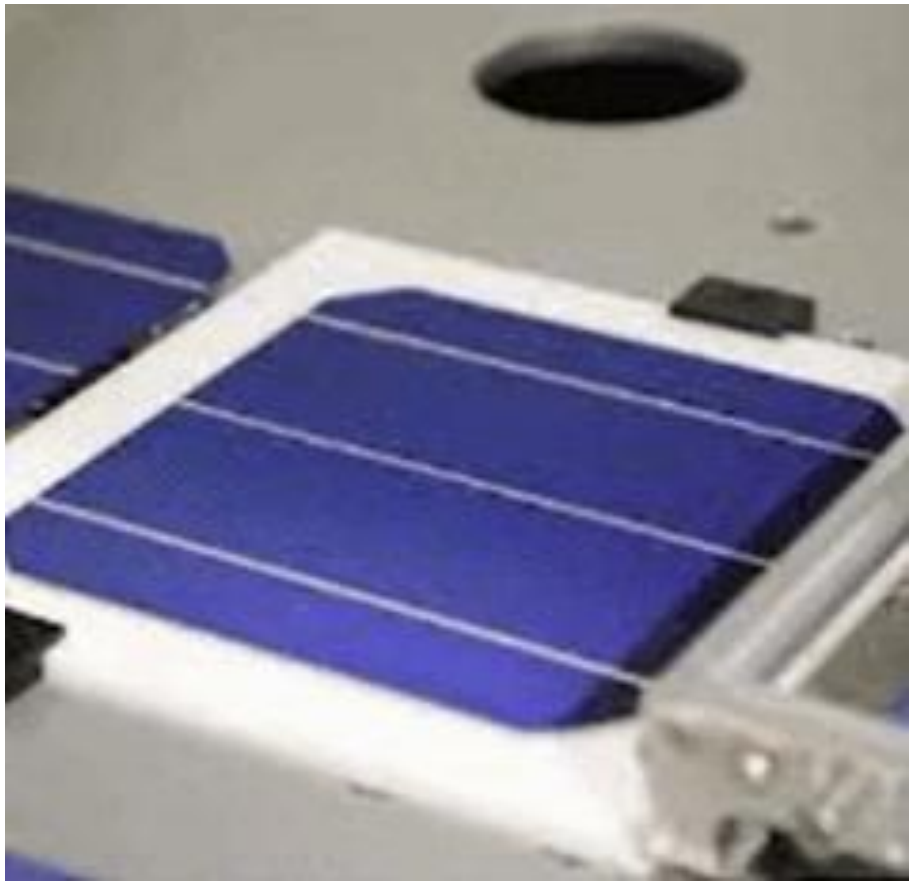
TechBlick
CONNECT · ENGAGE · LEARN

Process Innovations in Additive and 3D Electronics – From Analoge to Digital

Addressing issues like speed, resolution, digital, material choice, etc

Printed Electronics is Everywhere
- From diapers to precision missiles!



Agenda: „Process“ Innovations

From screen to dry inkjet less laser printing

#Screen #Capillary #Dispensing #Inkjet #EHD #Microdispensing #LIFT #LaserPrint #DryMultiMaterial and Beyond

No Time For Material or Application Innovations 😥 😥

THE FUTURE OF ELECTRONICS RESHAPED

BOSTON • USA • 2025
11•12 JUNE
CONFERENCE • EXHIBITION

70+ SPEAKERS

TALKS | 11 JUNE

TRACK 1

RIT · NASA Goddard · BOEING · essemtec

TRACK 2

SPARK · GE HealthCare · Heraeus Electronics

TRACK 3

UNIVERSITY OF MARYLAND · priways · CREATIVE MATERIALS

EPICORE BIOSYSTEMS · VTT · GlucoMedicum · Nagase ChemteX

HRL LABORATORIES · NOTION SYSTEMS · DRACULA · C-INK

brewer science · NOVACENTRIX · iris · penacol

iEE · Henkel · KIMOTO

IOTECH · ATLANT 3D · TEXAS

GrapheneDx · SunChemical · IdentifySensors

ACI · Satosen · NC STATE UNIVERSITY

Panasonic · CARBE CHEM · MACDERMID

Georgia Tech · ETS · THE UNIVERSITY OF CHICAGO

DRINKS RECEPTION

TALKS | 12 JUNE

TRACK 1

AmbAI · Jones · spgprints · FEDRIGONI

3DFlexible · Altium · RTX

NEXTFLEX · tracXon · IOWA STATE UNIVERSITY

E Ink · DEVCOM

TRACK 2

Fraunhofer IZM · Linxens · POLICROM · 日本カイテジ

WPI · ARKEMA · NAUTILUS DEFENSE

conductive technologies · Hotel Centre

MIT · NM STATE · VIBRANTZ

EVENT ENDS

75+ EXHIBITORS

essemtec · Henkel · Nagase ChemteX America · Heraeus Electronics · NOTION SYSTEMS

ACI · AKONEER · Altium · ARMOR GROUP · ERCON · FUJI

CoreAlign · conductive technologies · CREATIVE MATERIALS · East West · KIMOTO · Linxens

HUMMINK · INO · imageXpert · INTELLIVATION · Panasonic · POLICROM · privays

NanoPrint · NOVACENTRIX · penacol · SUSS · tracXon

SEFAR · SunChemical · SUNRAY · ARKEMA

spgprints · VTT · VOLTERA · XTPL · AGFA · AIXTRON · Fraunhofer

BotFactory · Brilliant Matters · Copprint · COVEME · FlackTek · FUJIKURA KASEI

GOT INTERFACE · GTM · KOMORI · LISAT · METALOR · MetaScreen

NBC · nsm · Nanointegris · sorolon · THIEME

TECHNIC · XENON · VFP Inc Technologies

THE FUTURE OF ELECTRONICS RESHAPED

BERLIN • EU • 2025
22-23 OCT
CONFERENCE • EXHIBITION

Perovskite Connect + THE FUTURE OF ELECTRONICS RESHAPED

The Co-Located Events Will Jointly Welcome

550 PARTICIPANTS

80 EXHIBITORS

70 PRESENTATIONS

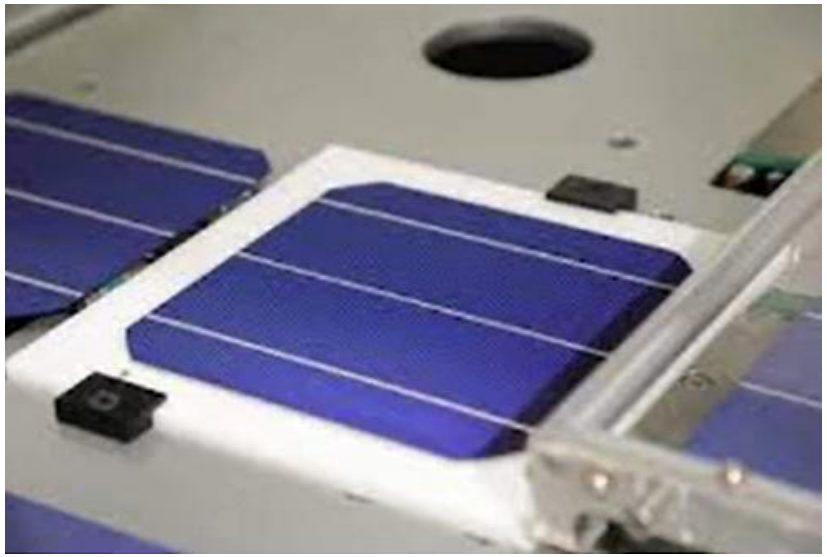
12 MASTERCLASSES

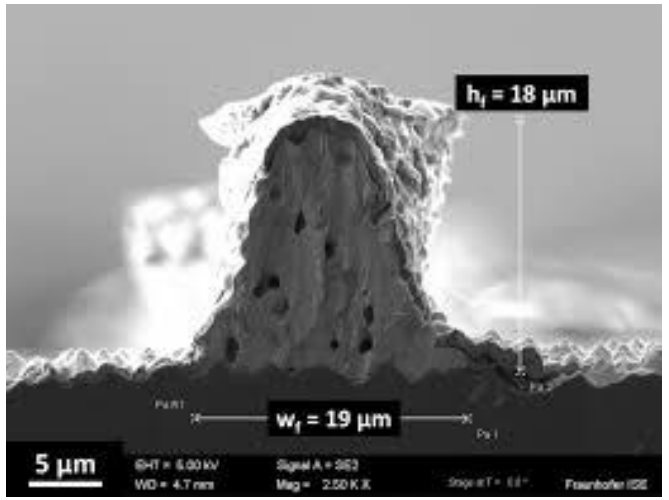
4 TOURS

22-23 OCTOBER 2025 | THE FUTURE OF ELECTRONICS RESHAPED

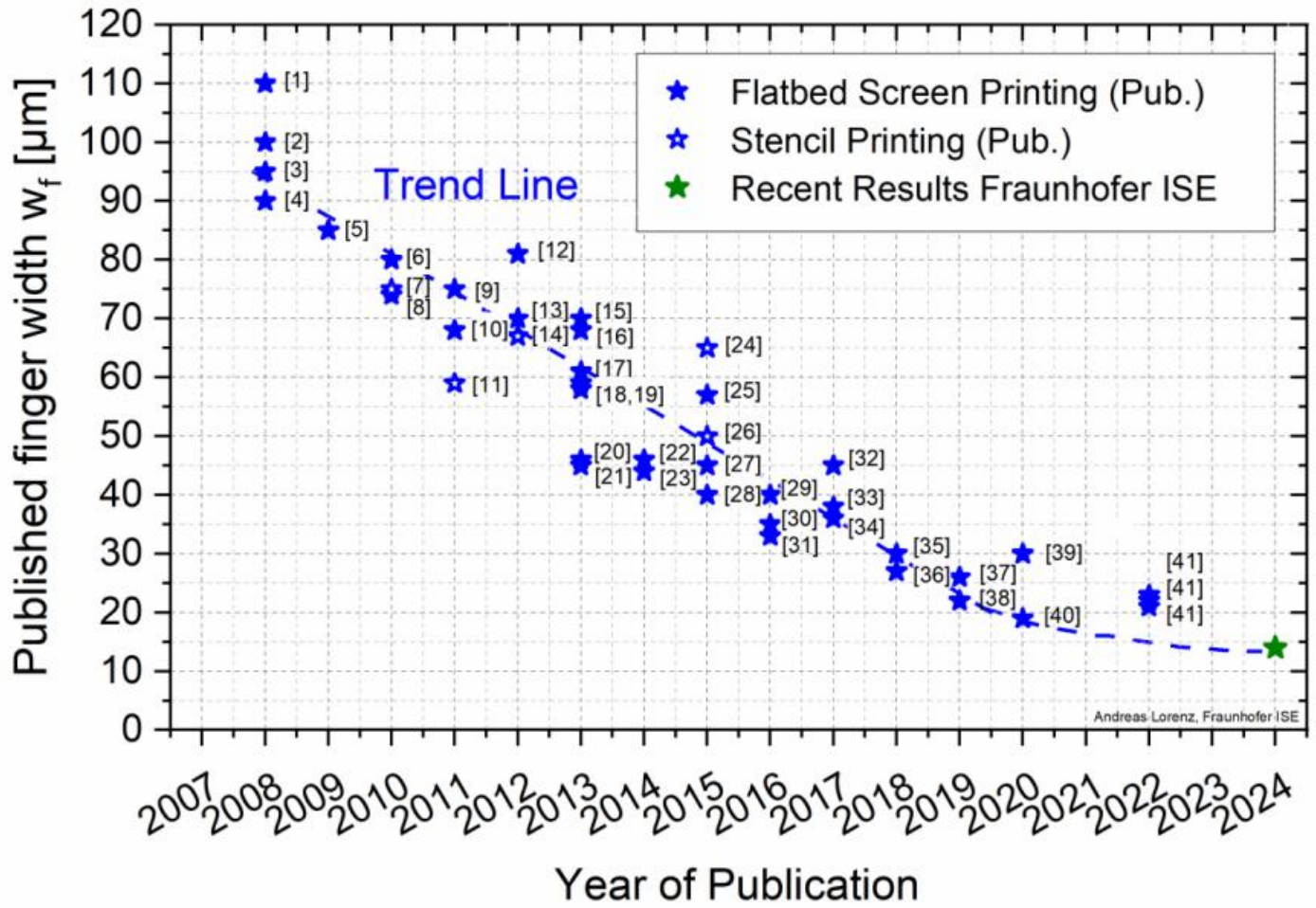
FLOORPLAN EUROPE

Incredible linewidth improvement in screen printed photovoltaic metallisation....



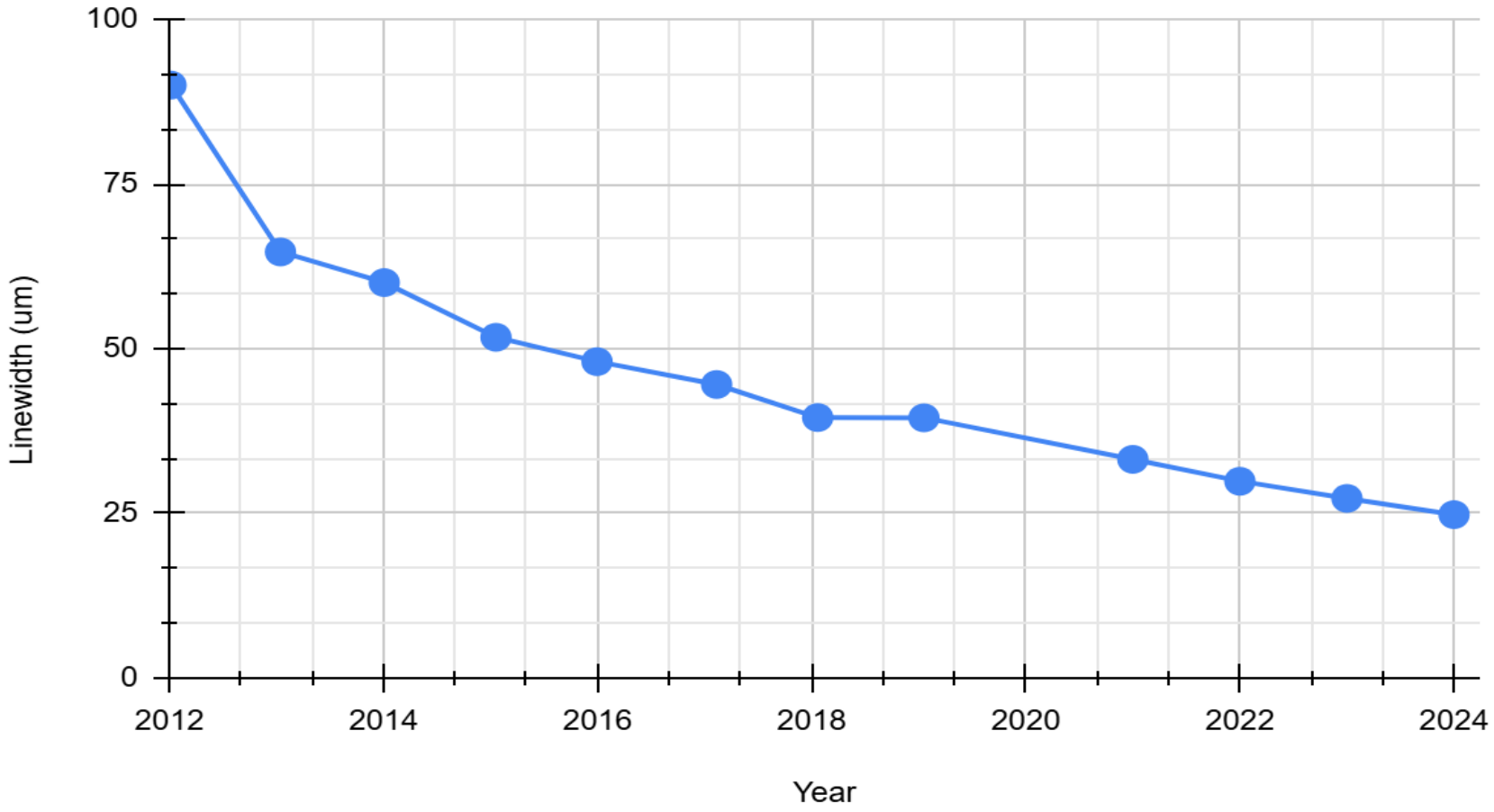


Reearch progress in ultrafine screen printed fingers



Sources:. Tepner & A. Lorenz, „Printing technologies..", Progress in Photovoltaics, 2023

And the industry has followed...



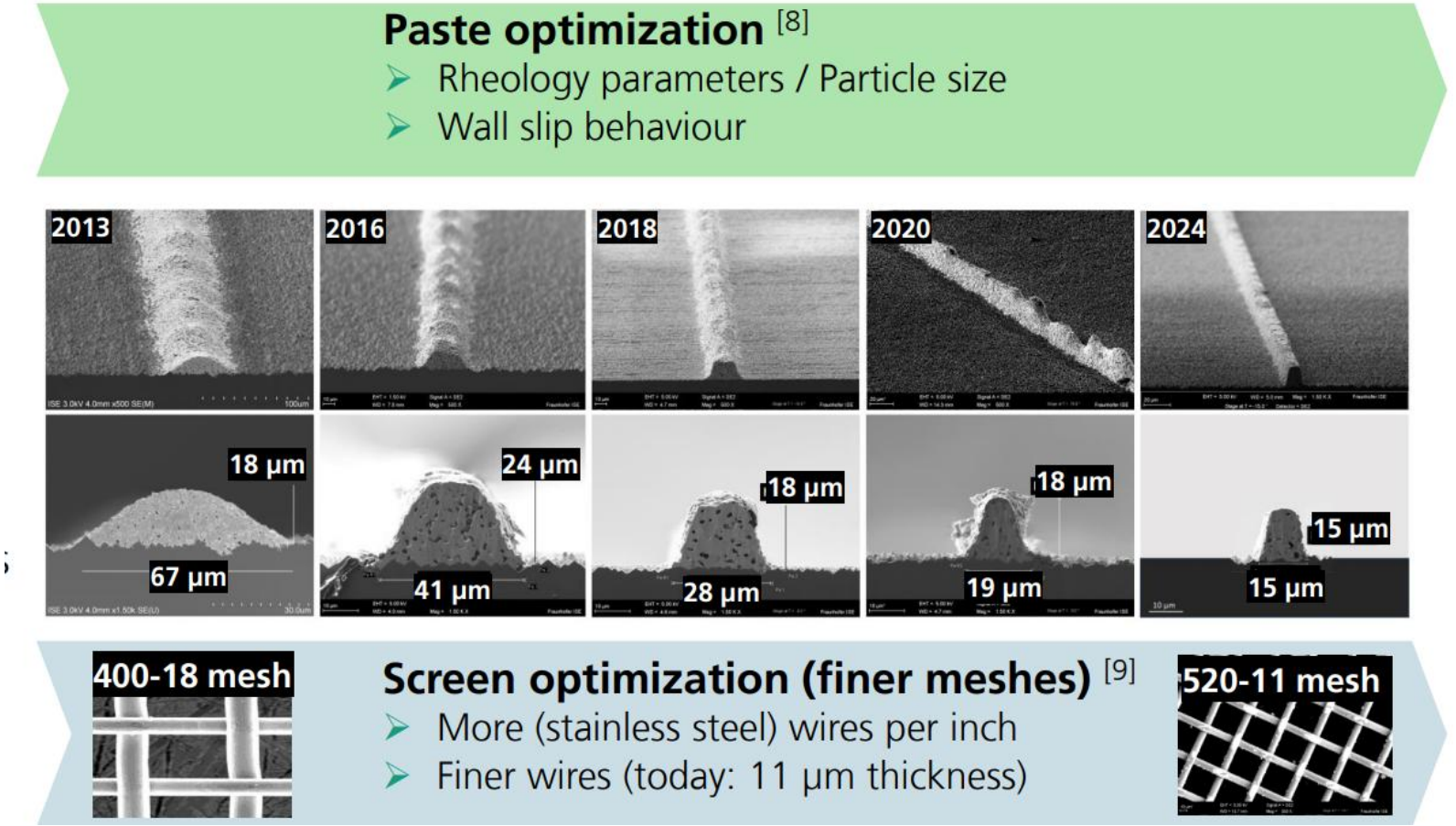
Sources:. TechBlick compilation from ITRPV roadmap data

Team work: Paste and screen evolution

Paste optimization (rheology, particle size, wall slip)

Ultra fine stainless steel meshes (today: 520-11 mesh)

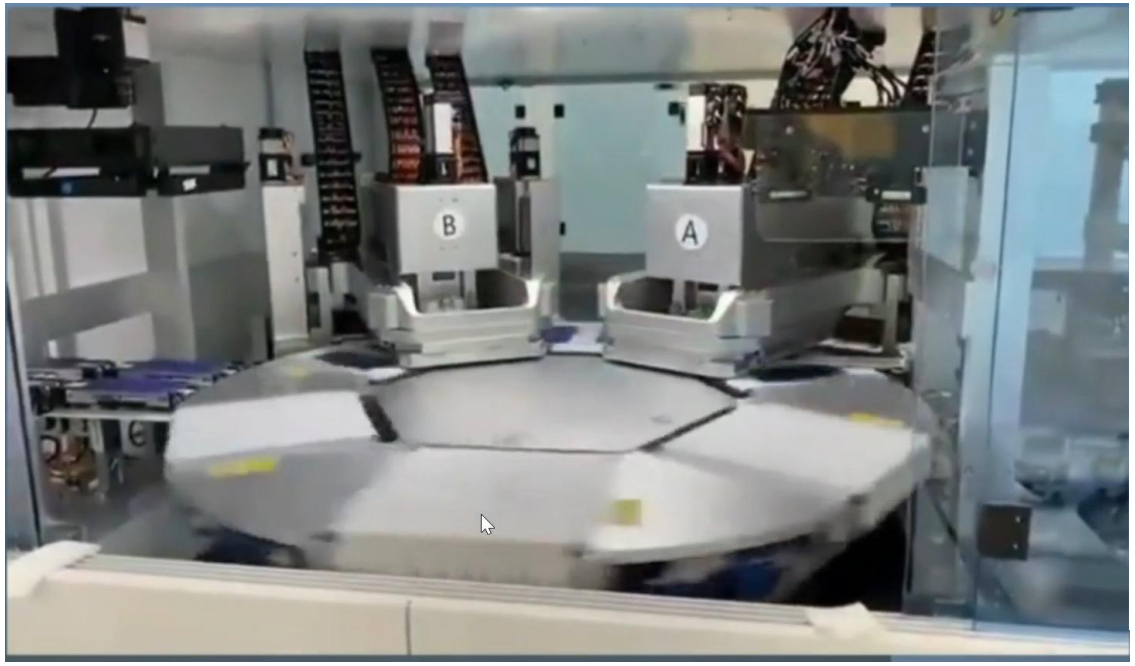
Laser opening of screens (channel width < 20 µm)



Sources: Fraunhofer ISE

Not just linewidth but also production speed...

Incredible print speeds and parallelisation



Source: Suzhou Maxwell Technologies Co., Ltd.

XDL-DP-Topcon

Item	182mm	210mm
Throughput	14400 pcs/h @half size	12521 pcs/h @half size
Printing Speed	490mm/s	400mm/s
Ink Return Speed	1300mm/s	1200mm/s
CT	≤1s	≤1.15s
Printing Accuracy	±20μm(Mark point positioning)	
Uptime	≥95%	
Breakage Rate @130μm	≤0.2%	≤0.23%
MTTR	2 hours	
MTBF	200 hours	

Half-cell TOPCon printing as example

Full wafer turnkey solution in industry now 8470 PCS Wafer/Hour @M10

Automatic full solar wafer screen printing

The "X" DUAL Lane production line provides a printing capacity up to 8,470 pcs/hour, a breakage rate less than 0.2%, and a printing accuracy up to ±6 μm, which significantly improves the throughput and yield of solar cells.

Compatible for M6 to G12 Wafer Size

7578 PCS Wafer/Hour @G12

8470 PCS Wafer/Hour @M10

NET THROUGHPUT :

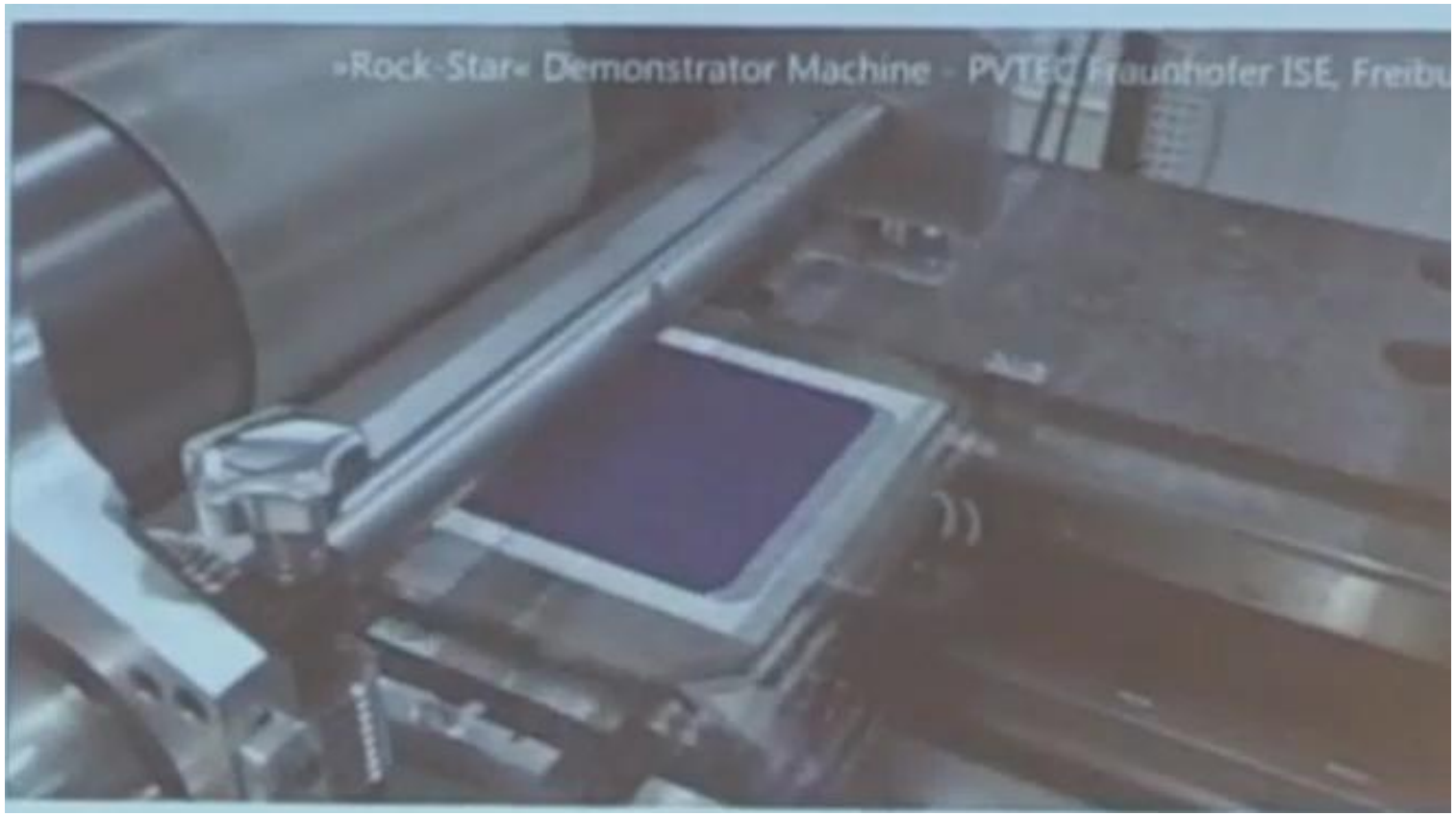
450 MW / Year for G12

580 MW / Year for M10

INTRODUCTION YEAR: MAY 2023

Item	Technical Index
Throughput (pcs/hour) and Wafer Size	8470 pcs@182mm wafer, CT≤0.85s; 7578 pcs@210mm wafer, CT≤0.95s;
Printing Accuracy	Up to ±6μm (Mark Point Positioning with 4 cameras)
Uptime	≥98%
Breakage Rate	≤0.2%
MTTR	2 hours
MTBF	200 hours

Can we do rotary screen printing....?



Rotary screen printing (single lane) → up to 8000 Wafer/h (cycle time of 0.45 s)

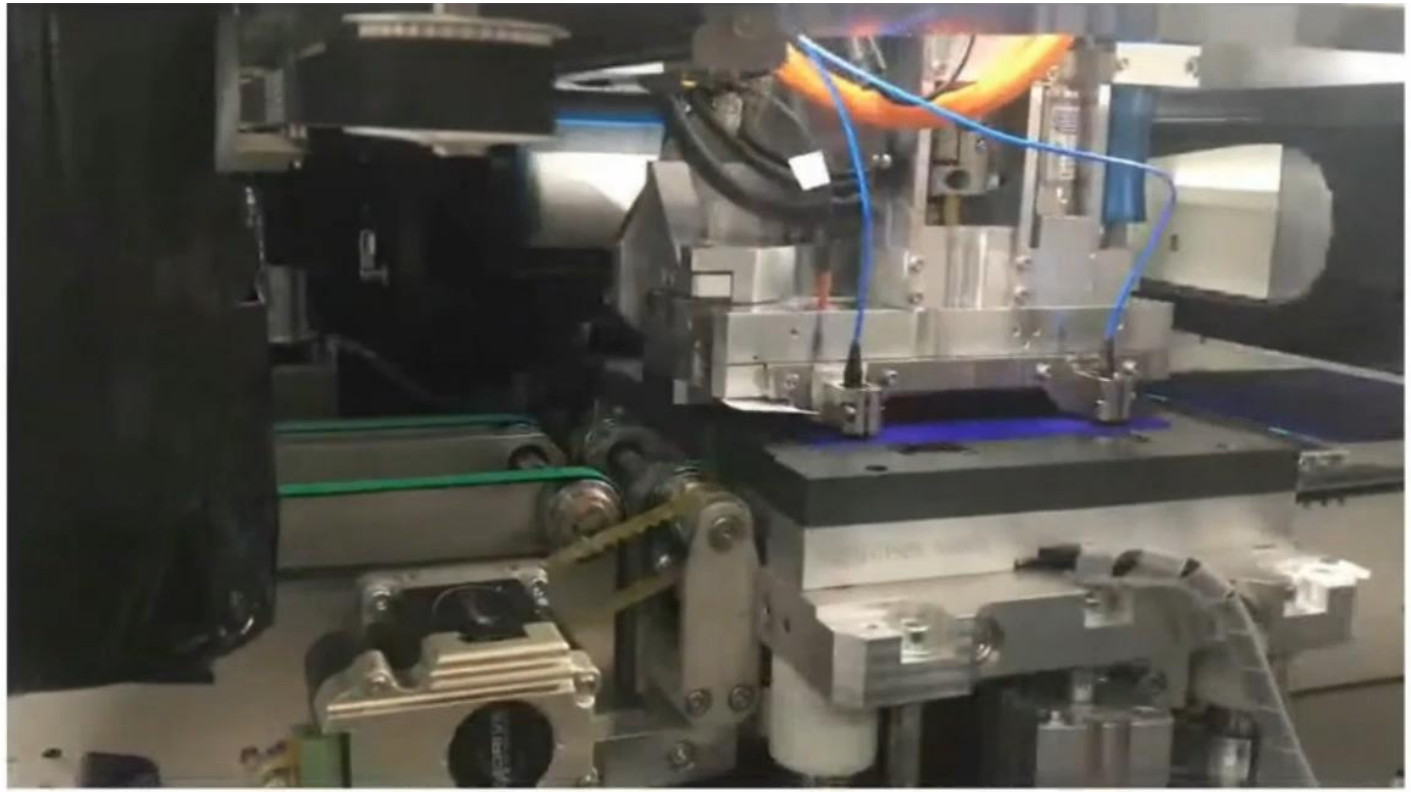
SHJ PVs

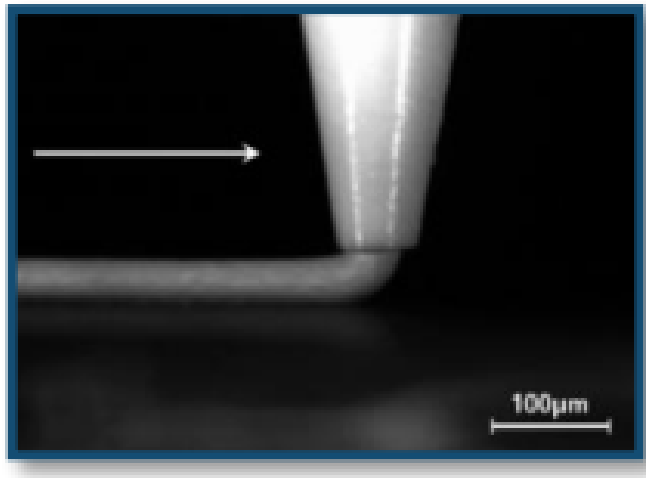
50um linewidth or so

Source: Fraunhofer ISE

And many approaches going beyond screen printing in photovoltaic metallisation....

Parallel homogeneous extrusion of metallization pastes





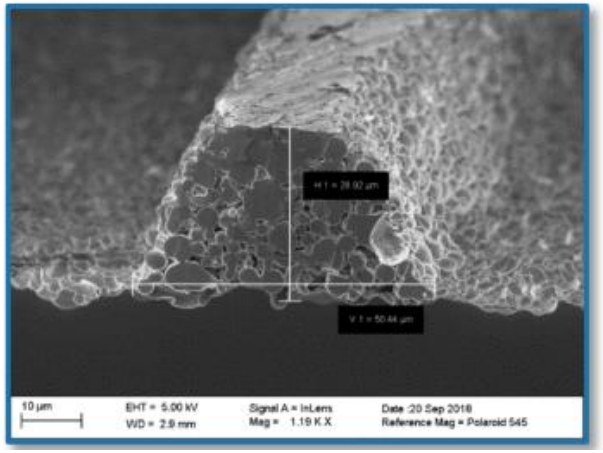
Finger width: 20µm

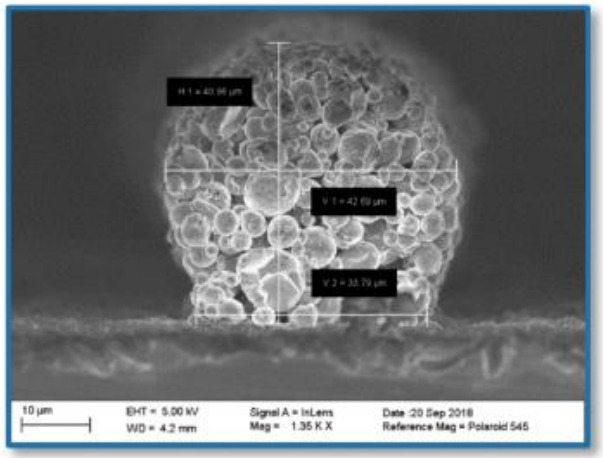
Speed: 500-1000 mm/s

Source: HighLine Technology

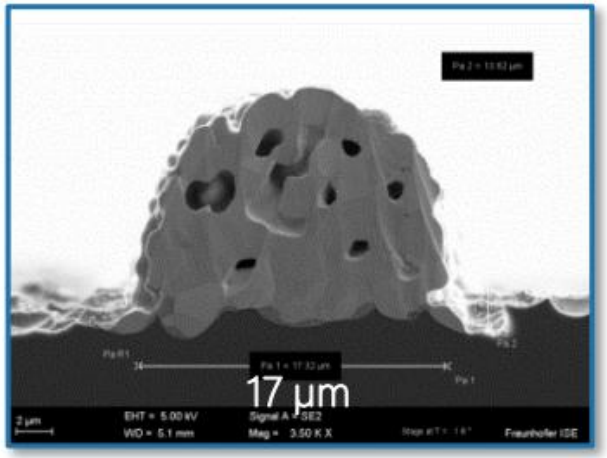
Narrow fingers with good aspect ratio.

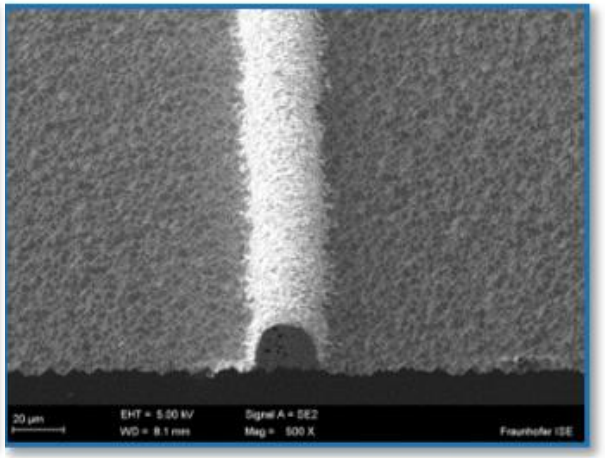
Aluminum





Silver

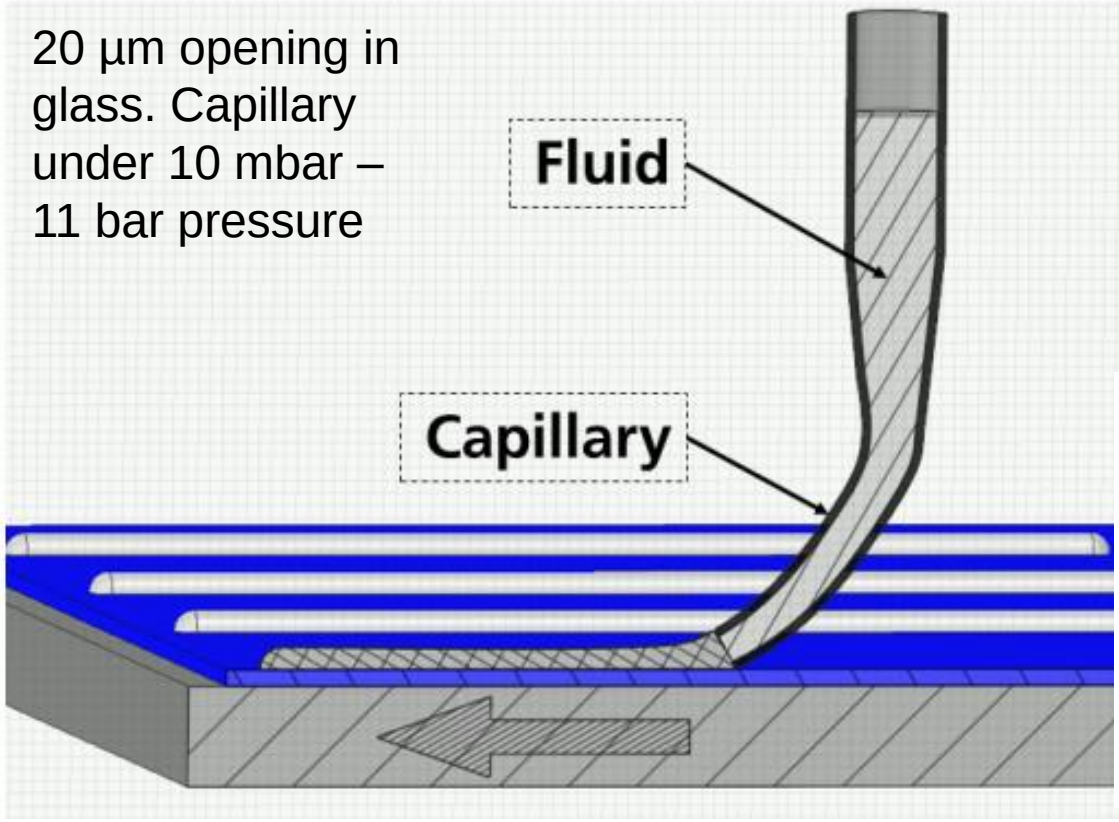




Source: HighLine Technology

Capillary printing under pressure

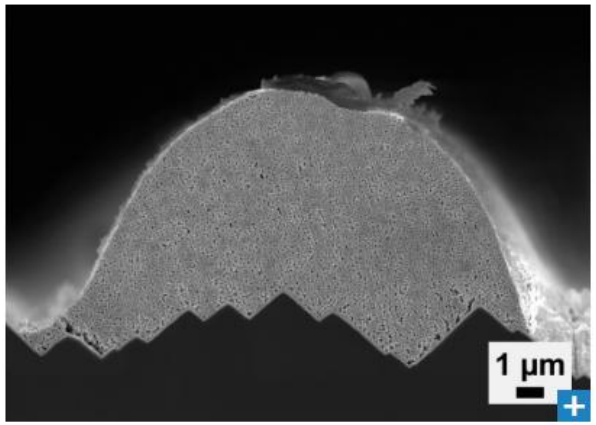
20 µm opening in glass. Capillary under 10 mbar – 11 bar pressure

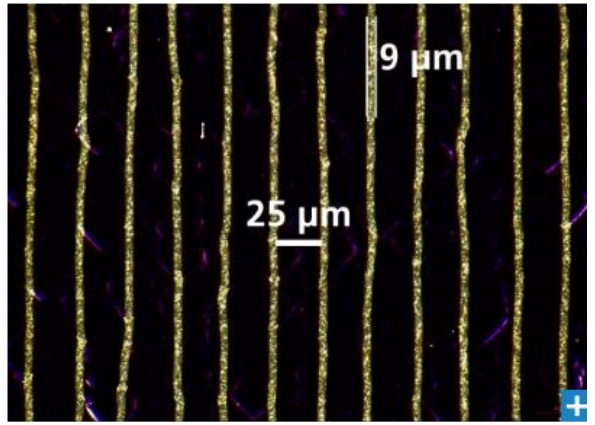


Finger width: 12 µm ▪ Finger height: 6.4 µm
SHJ efficiency 22.96 % ▪ 60% silver saving compared to screen printing

Speed can be 500mm/s

Ag NP inks





Source: Fraunhofer ISE

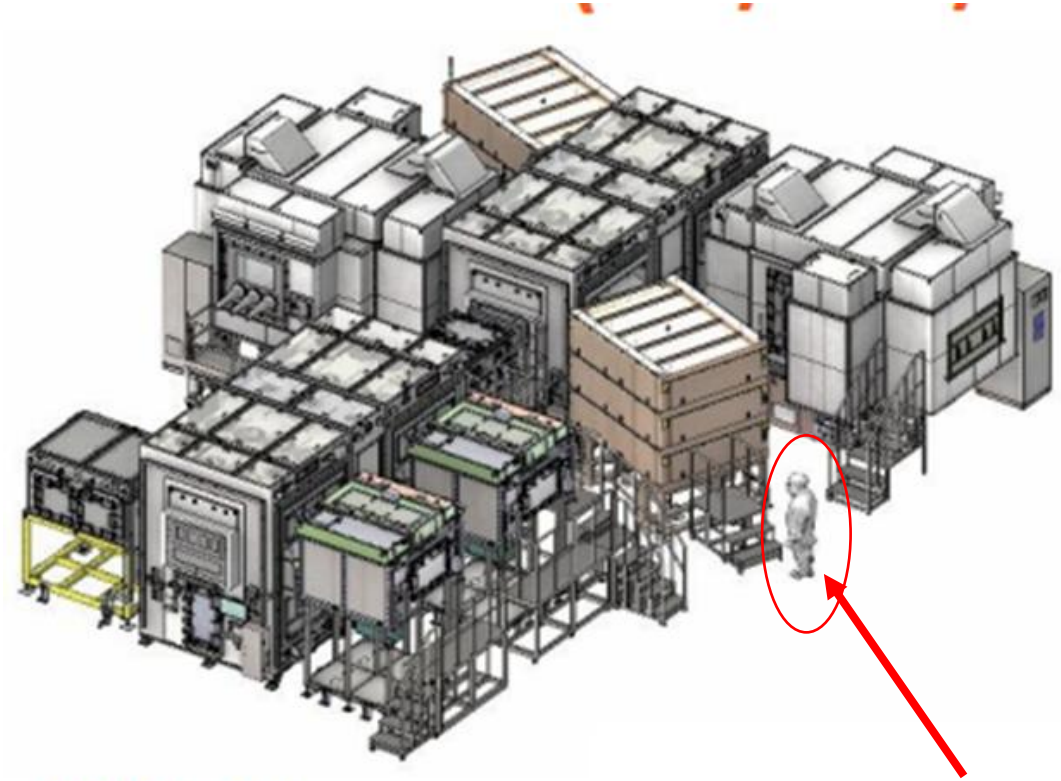
Now lets switch from analoge to inkjet and DIGITAL printing

Inkjet sets the reference but many questions: scale, stability, material choice, resultion, etc

So first question was: can IJP be scaled??

HUGE IJ printers for area and (future) pixel printing

Gen 6.5 (925x1500mm)



Source: Kateeva

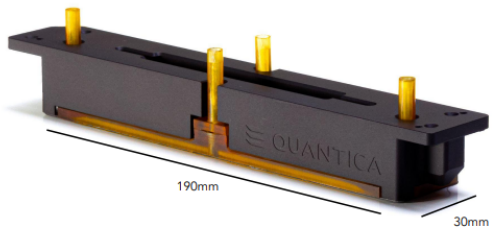
TechBlick

And can we digitally print high viscosity (even screen printable) pastes....?

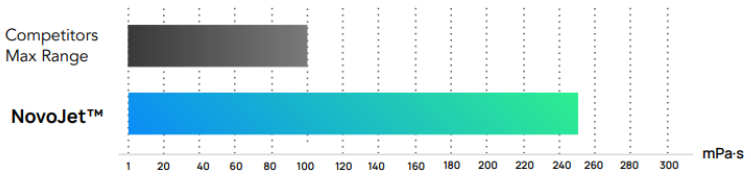
Jetting higher viscosity materials...

NovoJet™ Printhead

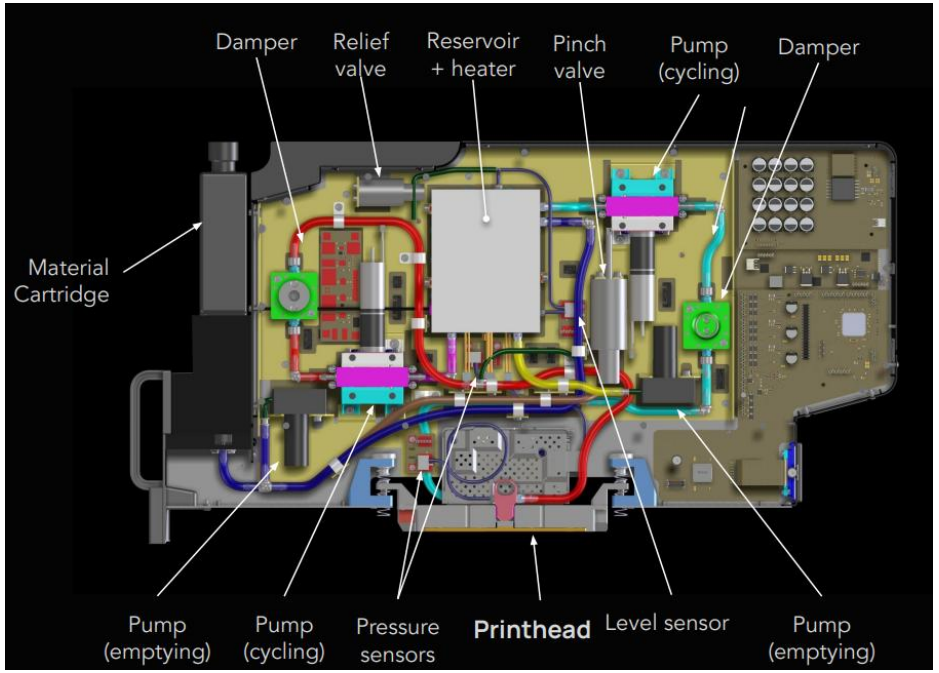
Developed by Quantica, manufactured by Xaar



Viscosity ranges (Jetting Temperature) of inkjet printheads on the market



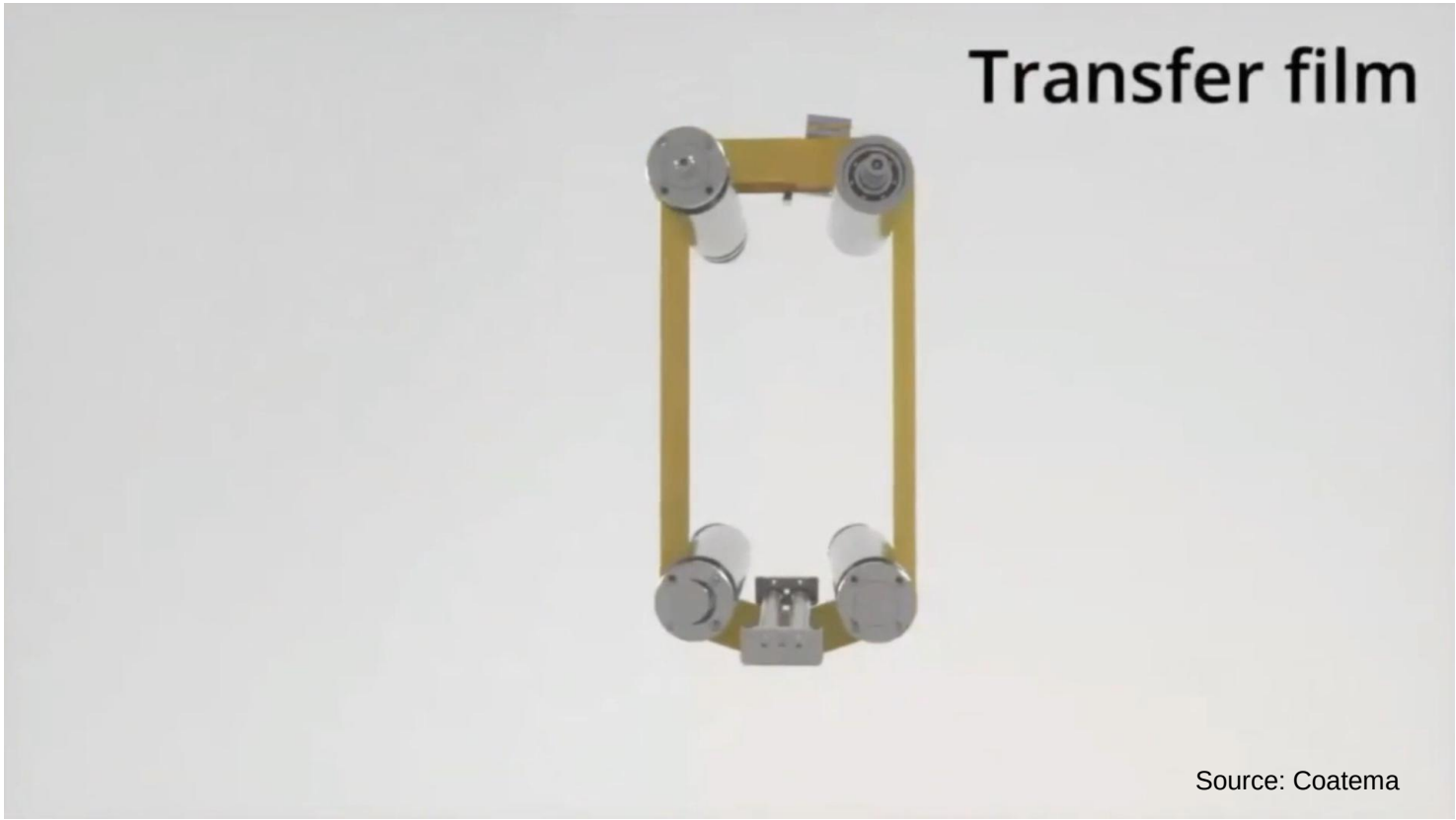
Nozzle Count	96
Rows of Nozzles	1
Nozzle Pitch	1.27mm
Fluid Viscosity Range (Jetting temp)	1 mPa • s – 250 mPa • s
Operation Temperature	15C-80C
Frequency	8kHz
Surface Tension	1-750 mN/m
Flow Type	Full Nozzles Recirculation
Nozzle Plate	Polyimide



- Curing starts in print head?
- Low nozzle count (20 per inch)

Source Quantica

LIFT: R2R digital laser printing of high viscosity materials



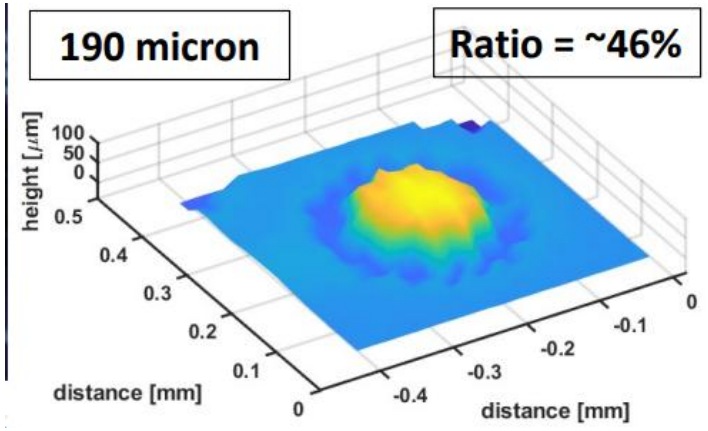
Source: Coatema

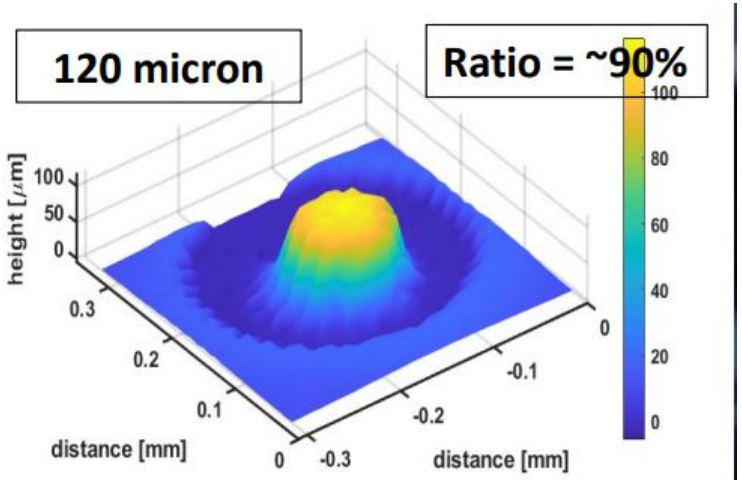
Wide range of viscosity with modest resolution

Material	Viscosity range (KcPs)	Cure type	Resolution	Filler size
Acrylate & Methacrylate	0.5-70	UV	40 µm	up to 2 µm
Epoxy - 2K	5-70	UV & heat	50 µm	up to 2 µm
Silicone - 1K & 2K	10-300	UV & heat	100 µm	up to 2 µm
Metal paste (Ag & Cu)	5-40	Sintering	80 µm	0.1-5 µm
Solder paste - type 4 to 9	20-40		50 µm - 250 µm	3-35 µm
Solder mask	20-40	UV / heat	40 µm	up to 2 µm
Polyurethane (acrylate)	0.5-70	UV	40 µm	up to 2 µm
Ceramic paste	0.5-70		40 µm	up to 2 µm
Carbon paste	20-40		100 µm	wires of ~10 µm
Polyimides	0.5-2	UV	40 µm	up to 2 µm

Source: io-Tech

Exmaple: Solder printing





T6@120um and T9@45um with 5M drops/hr (13888 dots per sec)

Source: io-Tech 2023

Can we do R2R with LIFT....

Print width 180 mm

Print speed 2-10 m/min

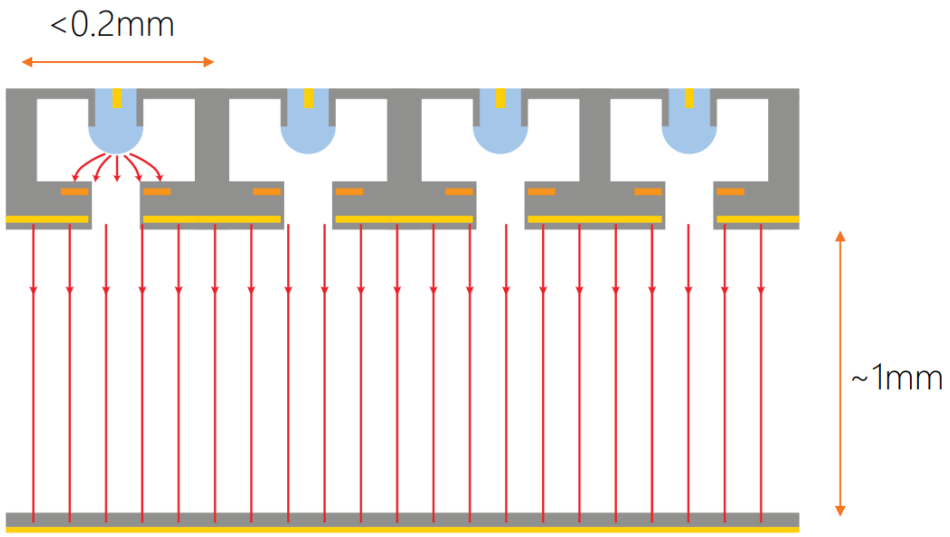
Resolution: up to 600 dpi

Source: Coatema

And can one have high viscoisty digital printing AND ultra fine resolution beyond inkjet...?

EHD Printing: MEMS multi-nozzles enable high productivity

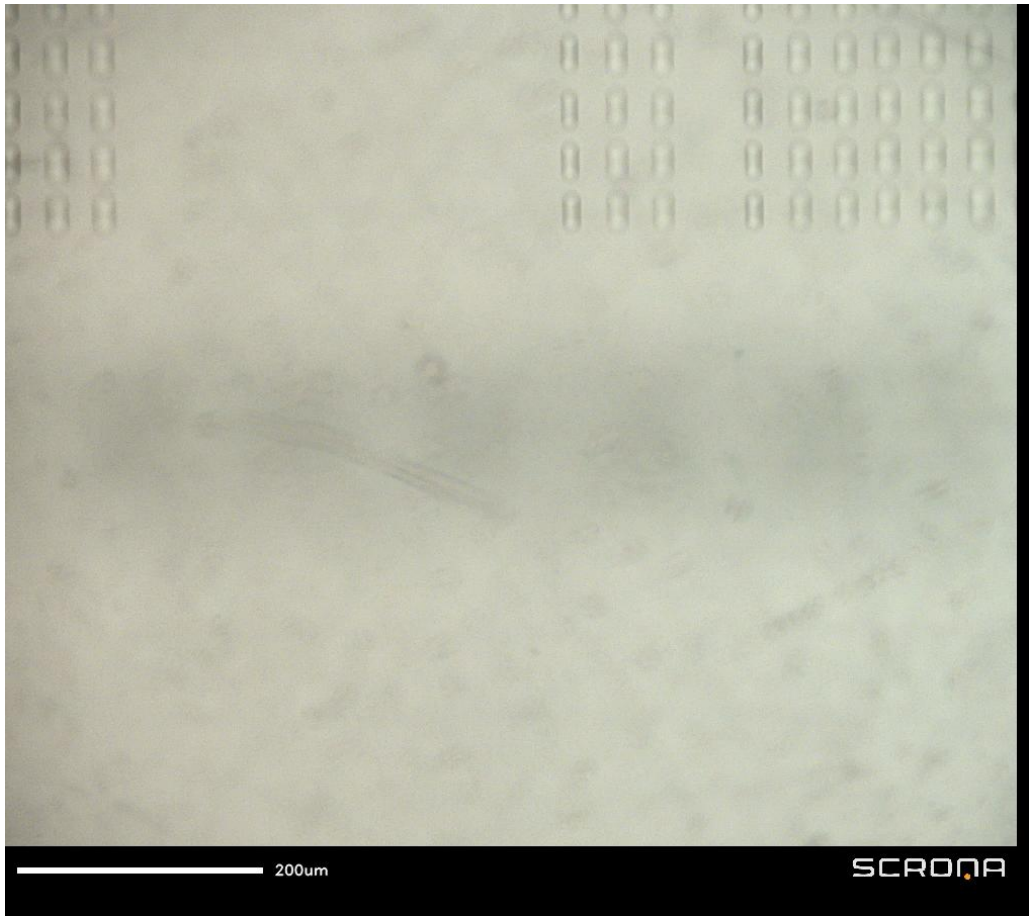
Scrona MEMS multi-nozzle printhead



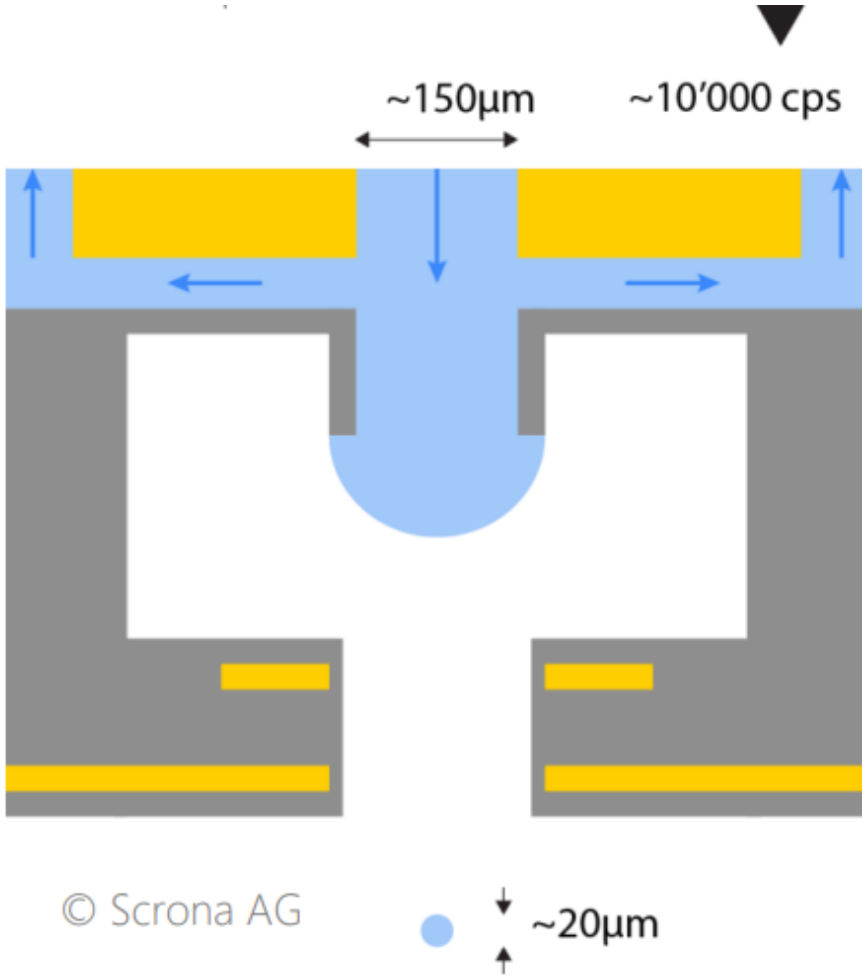
Resolution < 0.5 µm
Viscosity >10’000 cP

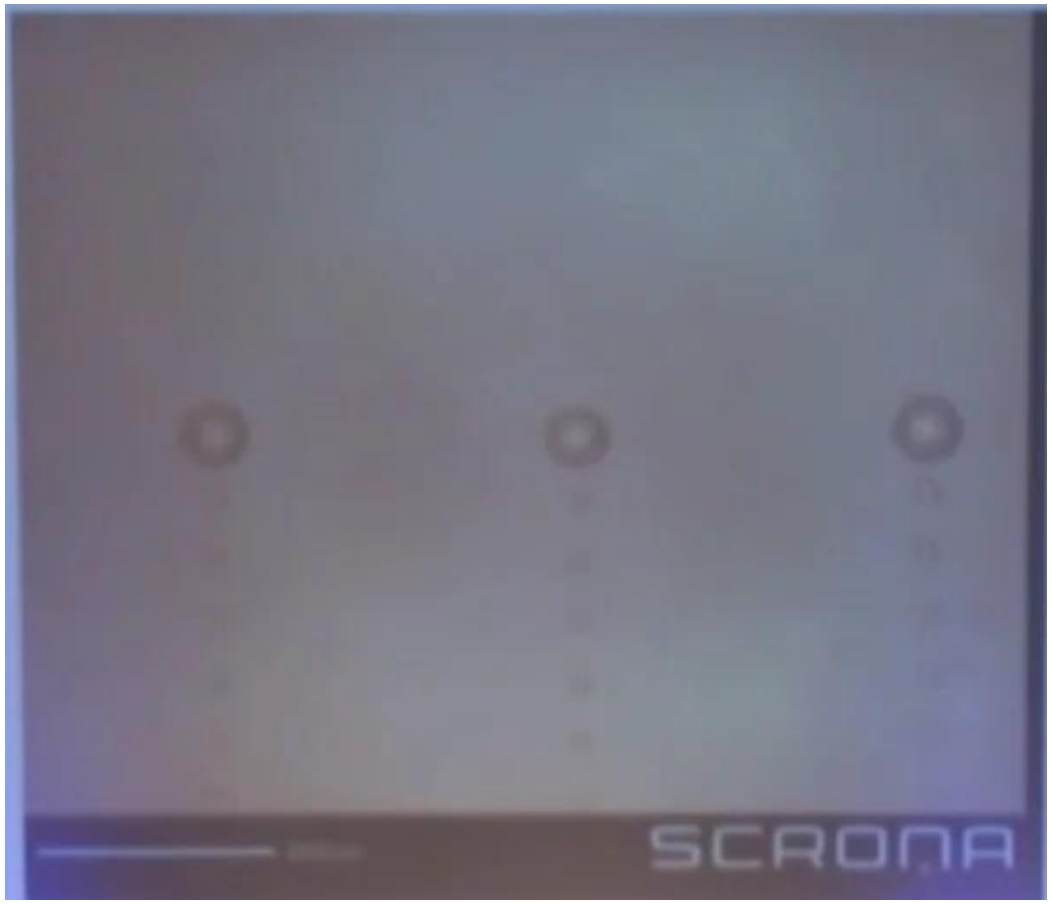
Source: Scrona

Printing QDs with 128 heads



But how to accomodate really viscous pastes like adhesives with EHD printing...?

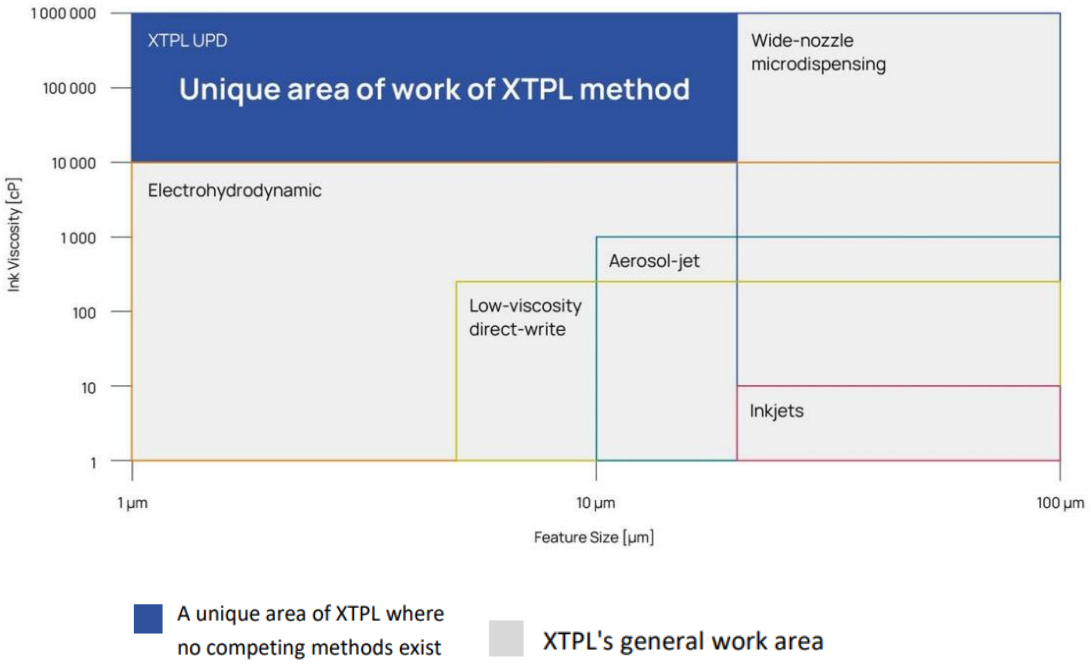




Threebond 3065E, 7Pas/700cP, printing at up to ~100Hz Size of droplet easily adjustable from below 10micron to >50micron

But can we go even higher viscosity levels for eg higher conductivity without e-field?

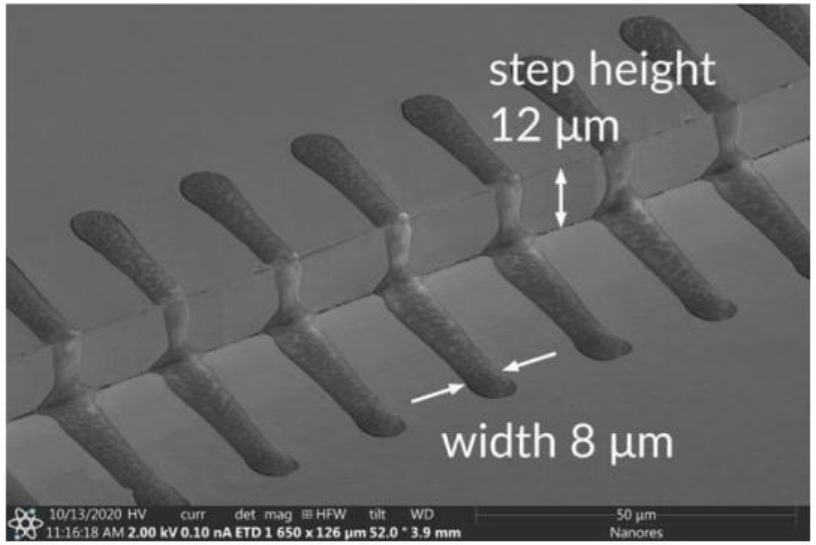
Micro-dispensing technology (UPD)

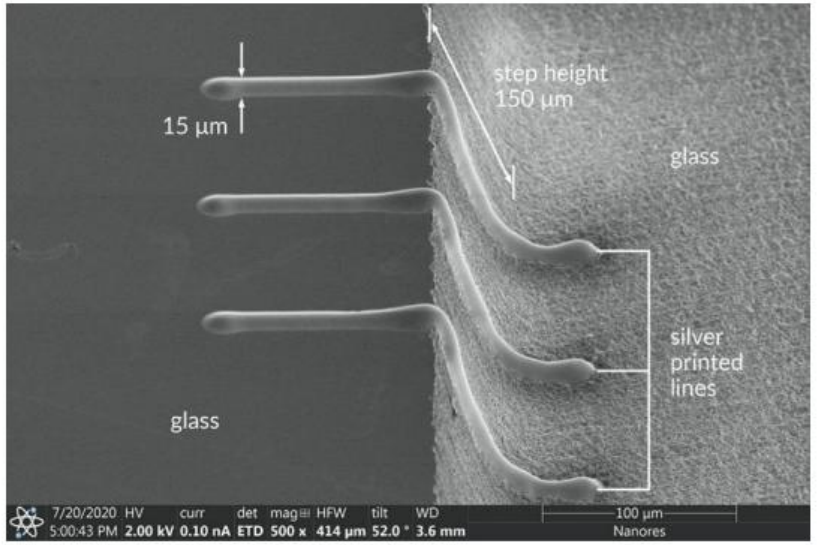


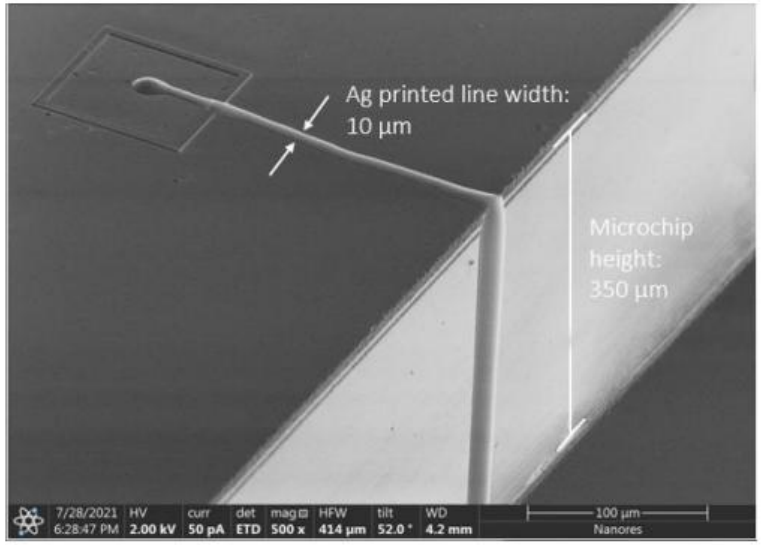
Source: XTPL

Can we print with UPD in 2.5D and 3D?

Covering vertical steps even above 300 µm height







12 µm step

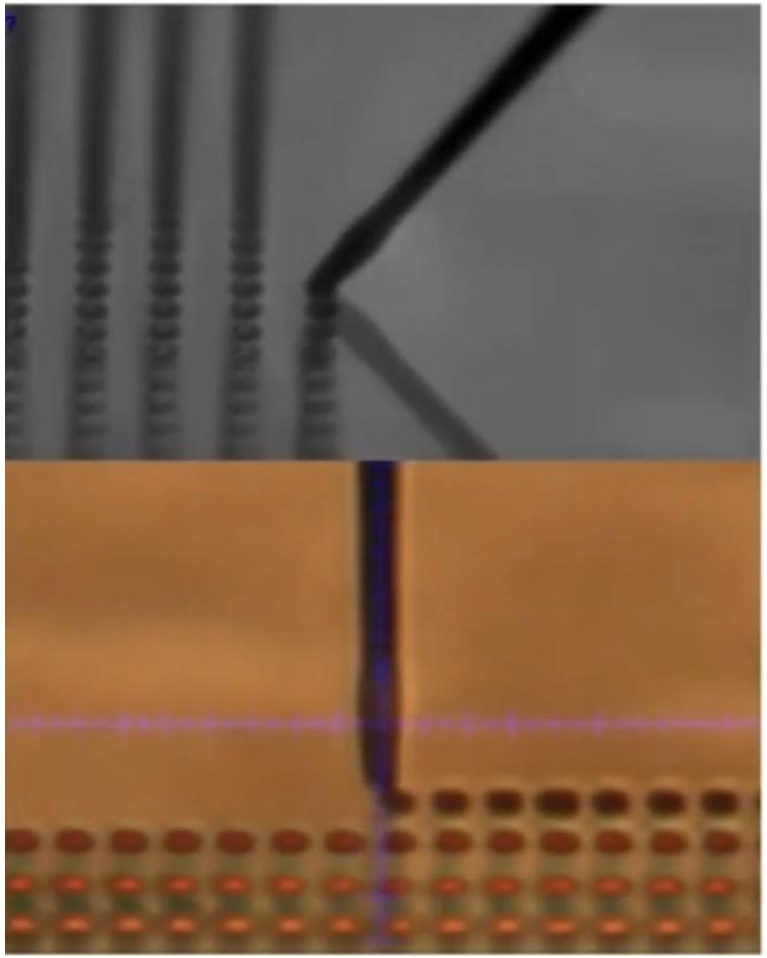
150 µm step

350 µm step

Source: XTPL

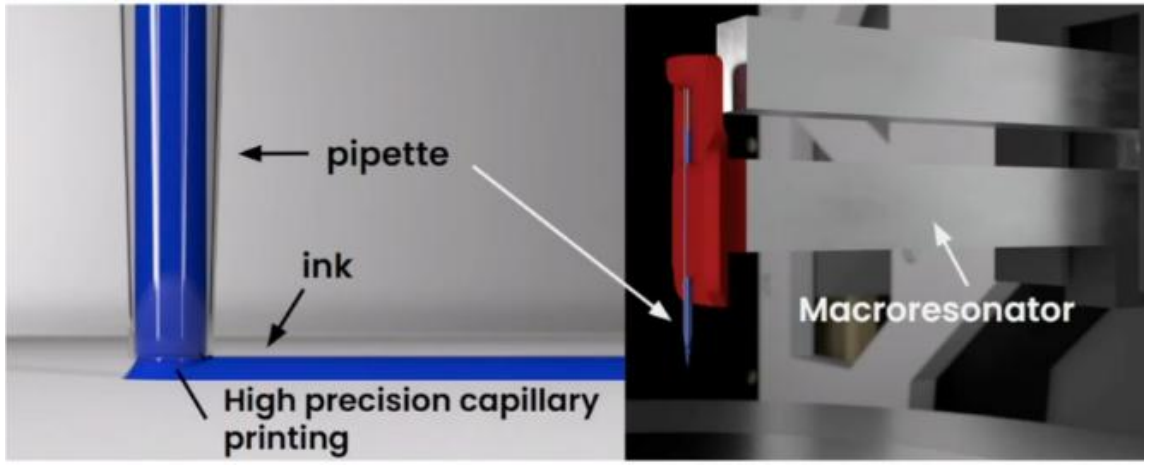
Too slow?!

8.3 dots per second



Source: XTPL

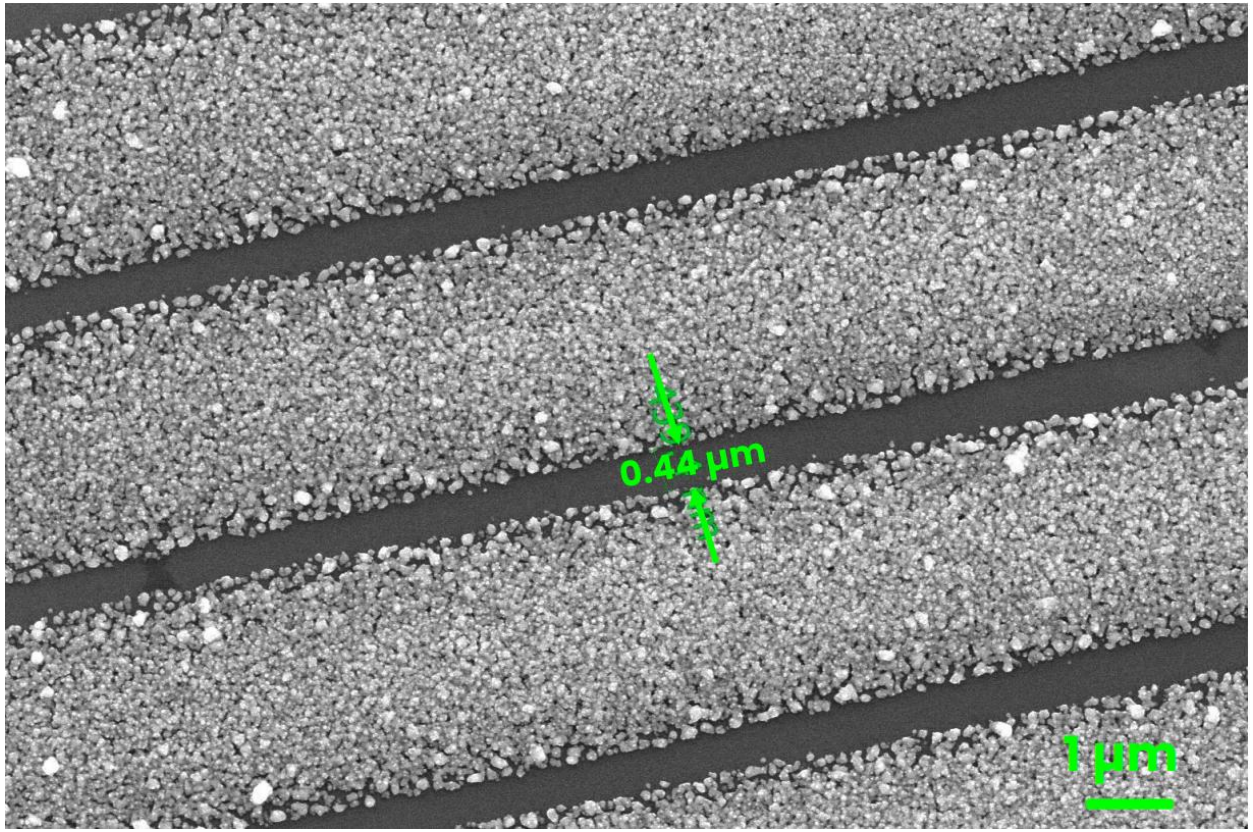
High Pressure Capillary Printing



No satelite or no splashing since printing head is very close

Source: Hummink

Fineline and even single-print micro-bumps

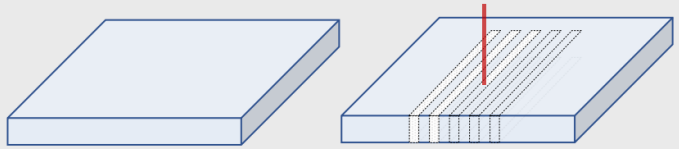


Source: Hummink

And can we additively manufacture WITHOUT inks??

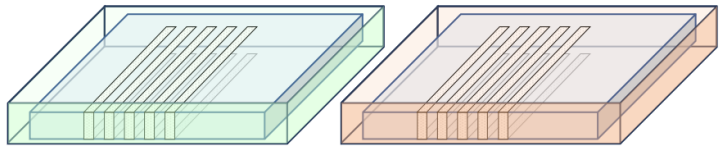
SSAIL Process: Additive laser-induced metalisation of **diverse surfaces**

1.



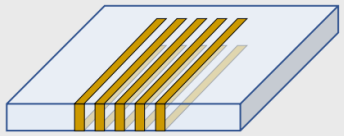
Laser process on blank substrate (including via drilling if needed)

2.



Chemical process
1) Activation
2) Electroless plating

3.

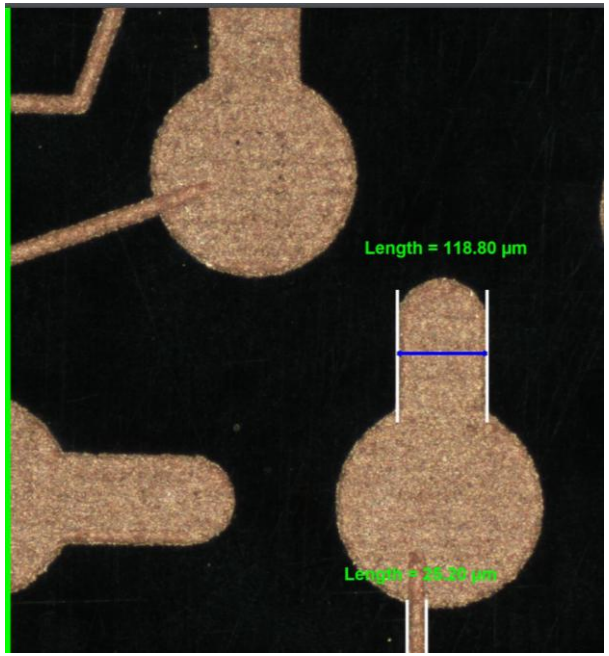


Final plated part

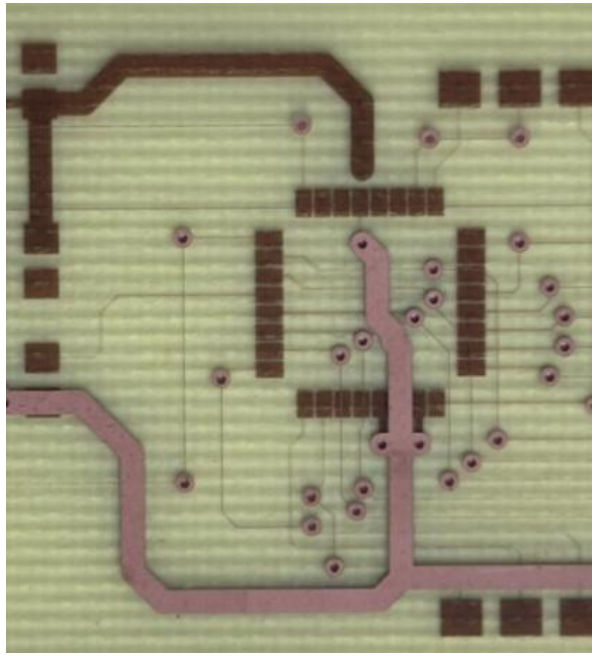
- Trace width down to 1 µm, sweet spot at ~10 µm
- Laser writing speed: >3 m/s @10 µm
- Laser writing speed: >0.2–1 m/s @2 µm
- Electroless plating: 3–4 µm/h
- Process temperature: <70 °C
- Conforms to automotive adhesion requirements

Source: Akoneer

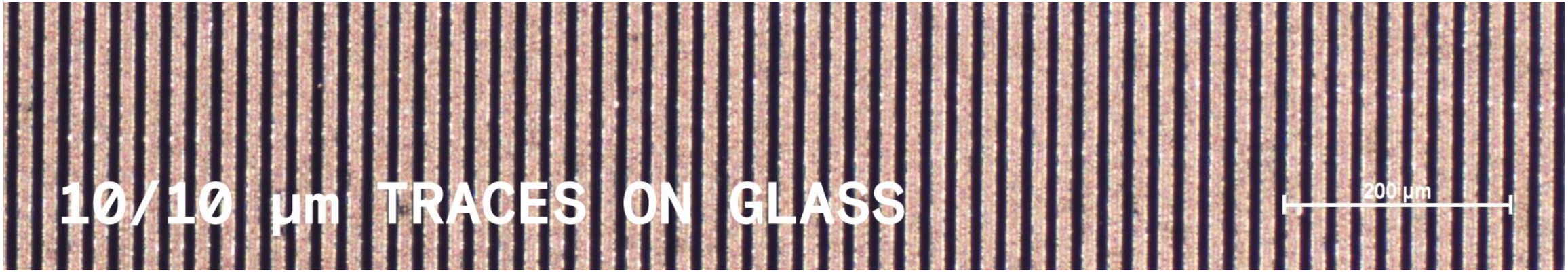
Fan Out on PI



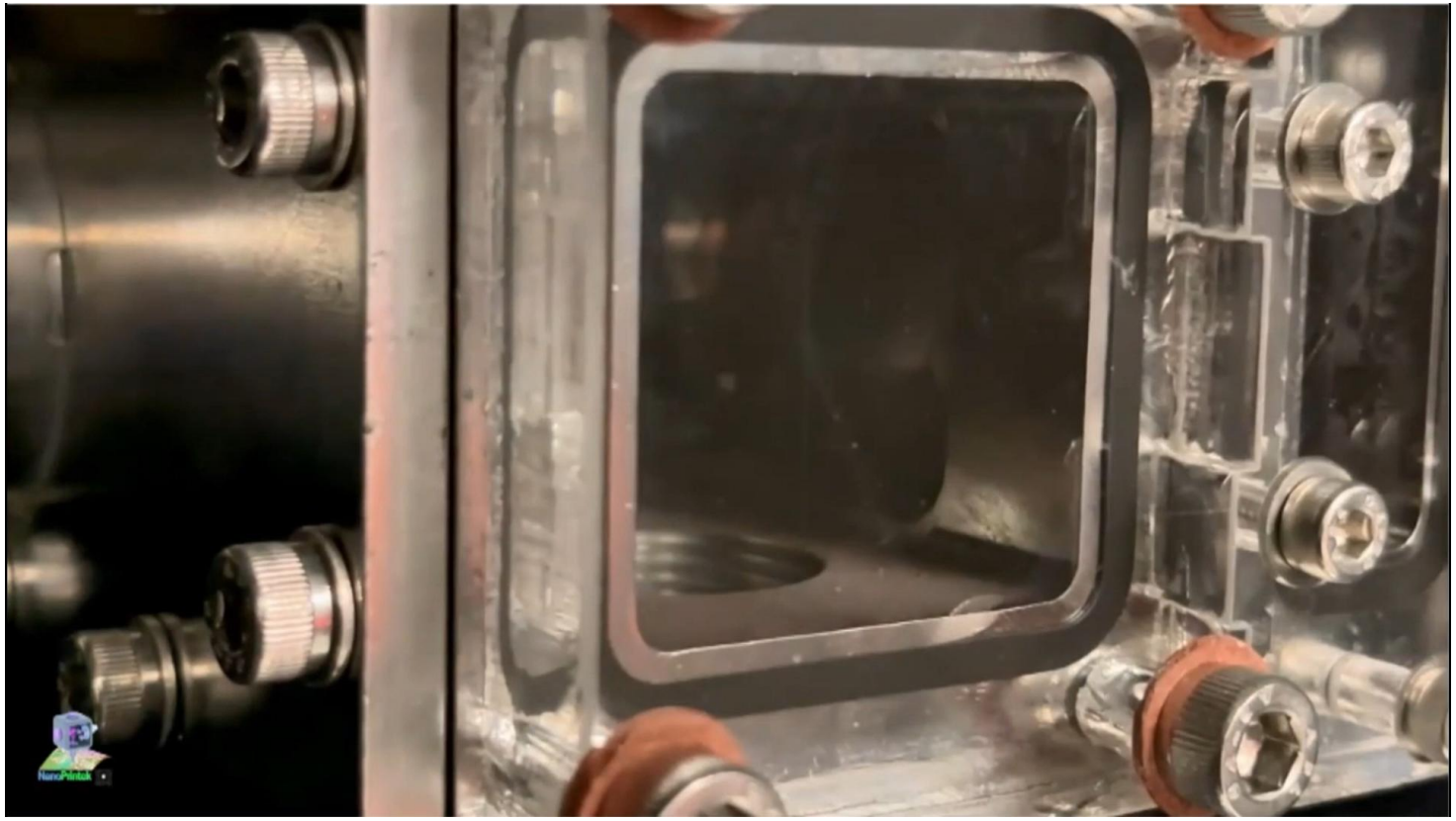
15um on FR4 (sensitive surfae!)



Source: Akoneer

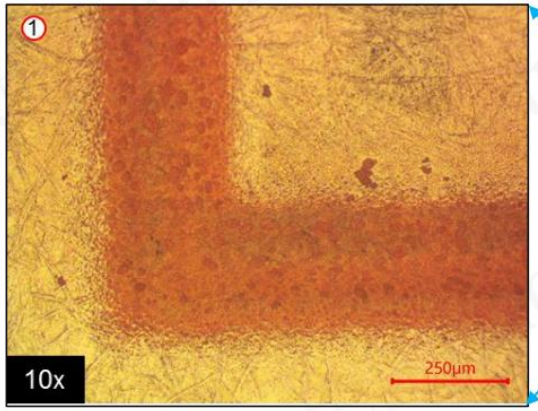


DRY (**Ink-Less!**) Mutli-material Printing

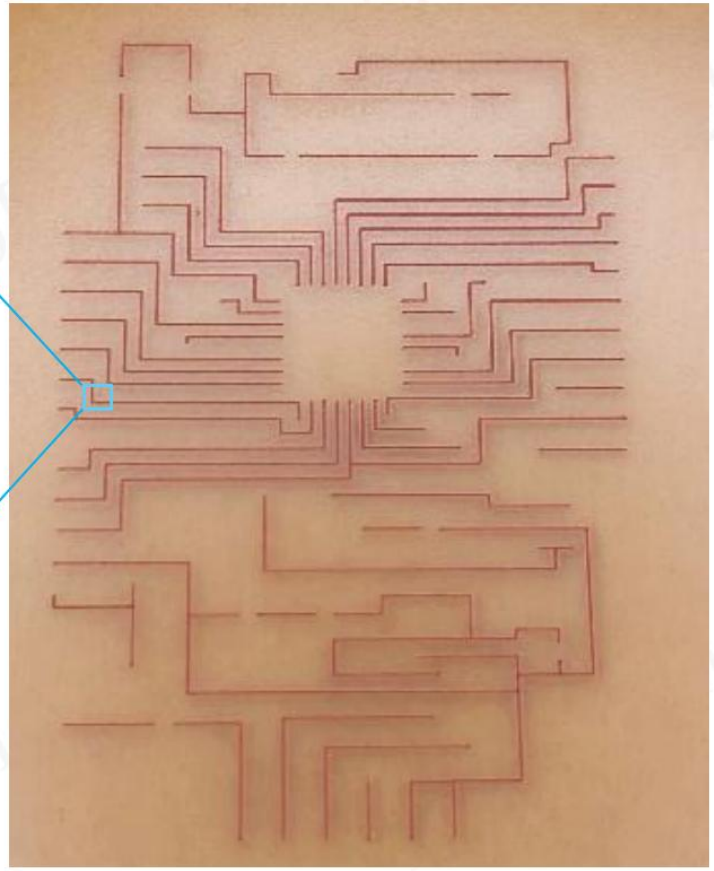


Source: NanoPrintek

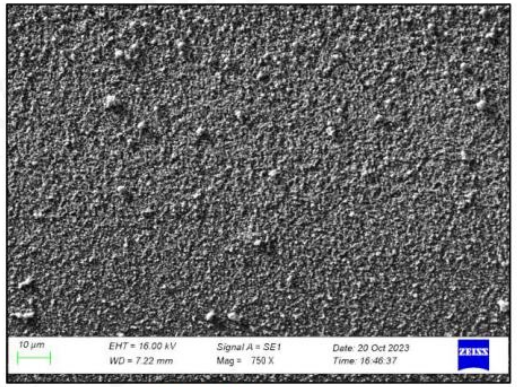
FR4 Substrate



Optical Imagae



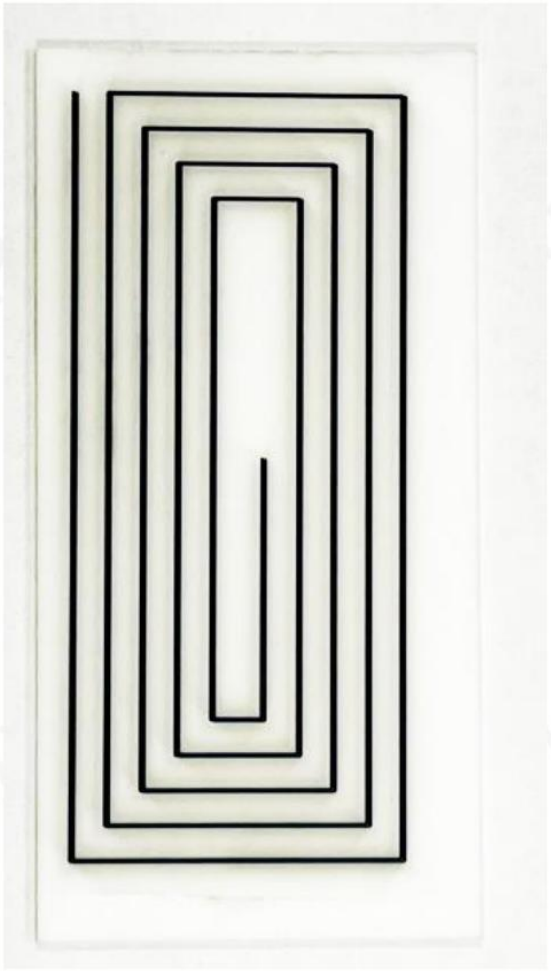
Optical Image

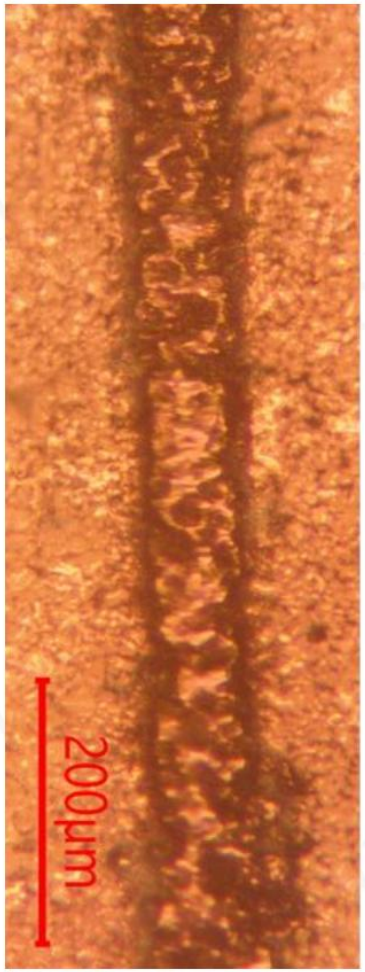


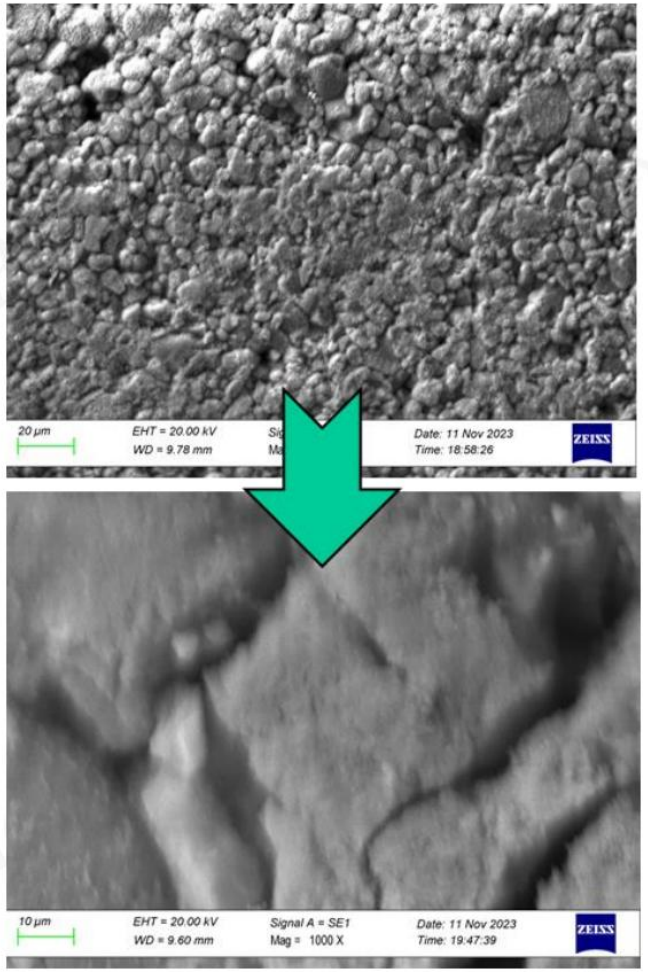
SEM image

Source: NanoPrintek

Tungstan

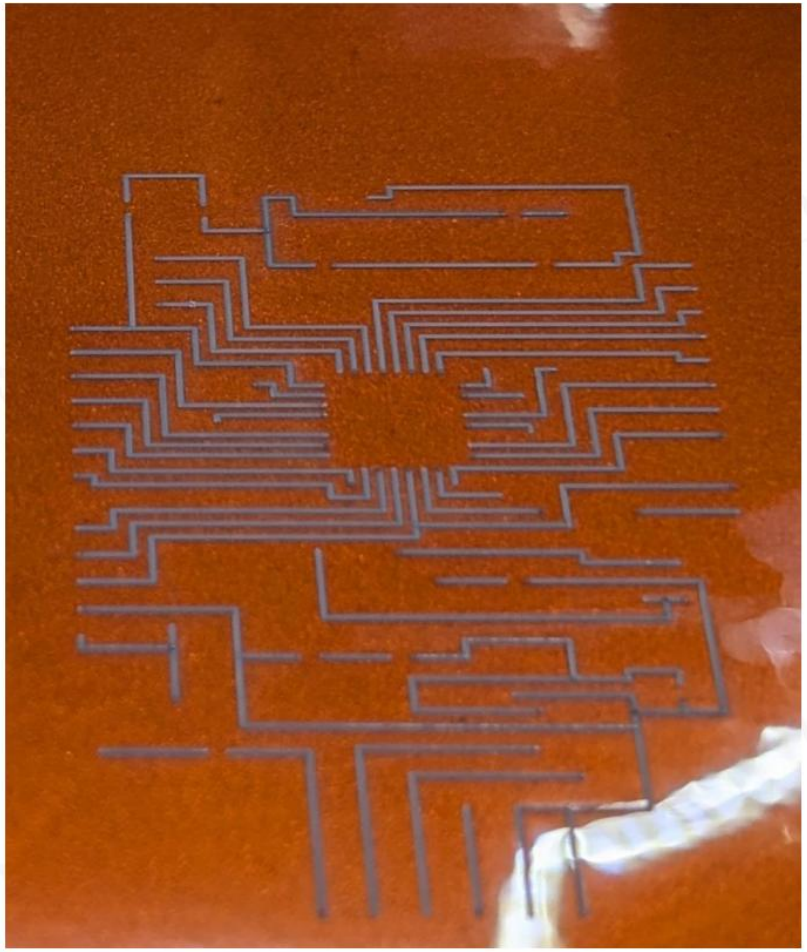


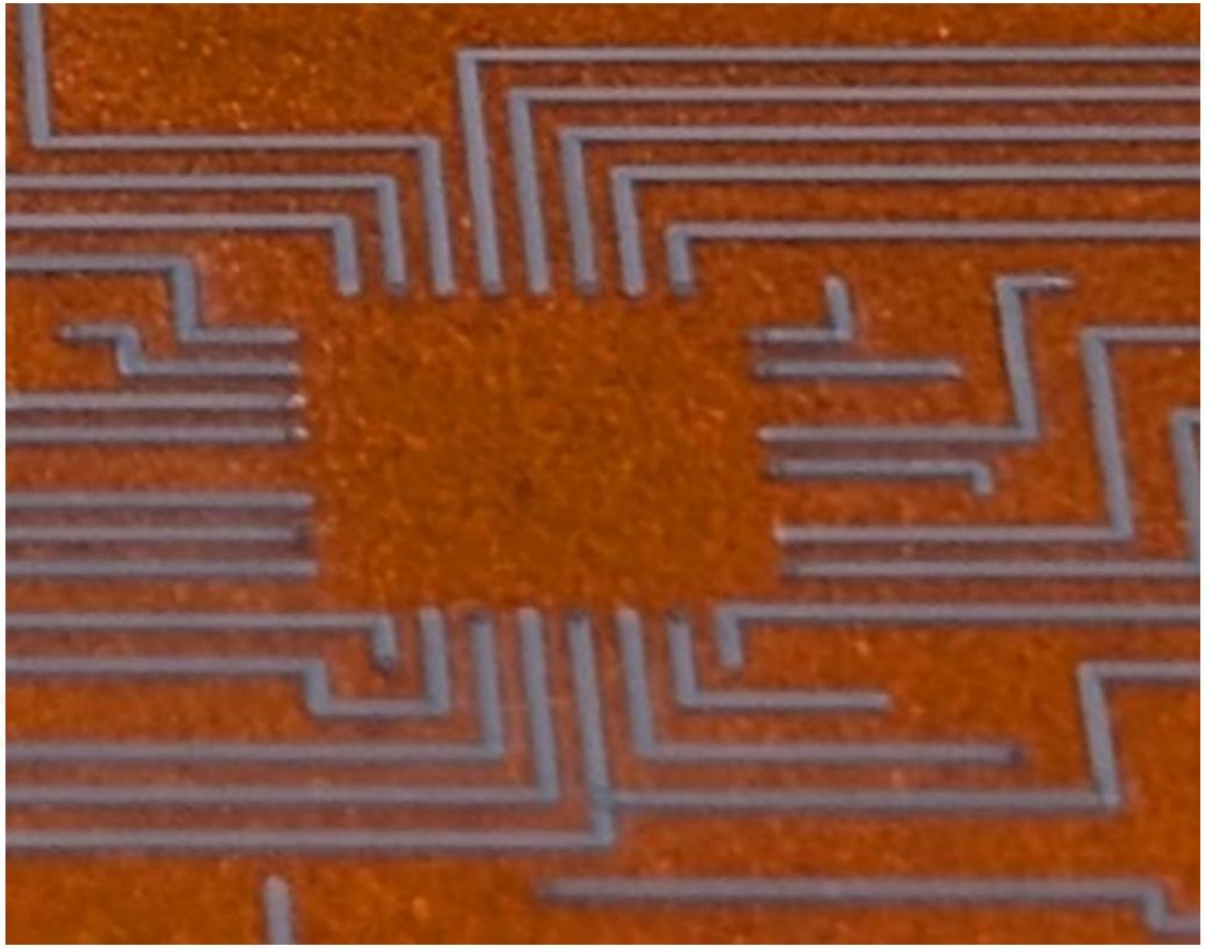




Source: NanoPrintek

Platinum





Thank you

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HRL LABORATORIES · NOTION SYSTEMS · DRACULA · C-INK

brewer science · NOVACENTRIX · iris · penacol

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ACI · Satosen · NC STATE UNIVERSITY

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