



Laser Pattern Transfer Printing for High-Viscosity Pastes

**Enabling Future Challenges in Photovoltaic Metallization
Microelectronics and Advanced Packaging**

Company Introduction



DR Laser (300776. SZ) is a high-tech enterprise committed to developing advanced technologies for laser applications, focusing on the photovoltaic, next-generation display, and semiconductor industries. It provides customized solutions integrating design, R&D, and manufacturing for high precision laser processing equipment.

Israel Global R&D center
Photovoltaics & Semiconductors
Est. 2009 /M&A 2020



Singapore Asia-Pacific R&D Center
New Displays & Semiconductors



Wuhan valley of optics
headquarters R&D, production,
sales and customer service.
Est. 2008



Wuxi
R&D and production



Business Landscape – Photovoltaic Technologies



Laser Ablation System



Laser Enhanced Passivation System



Laser Pattern Transfer Print Line
PTP™



Laser Doping System



Laser Non-Destructive Scribing System

>80% Market Share

>6000 systems delivered since 2012



Business Landscape – Semiconductor & Display Technologies



Through-glass via (TGV)



MicroLED Laser Transfer



Laser-Assisted-Bonding



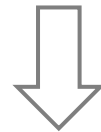
Laser Wafer Cutting

Pattern Transfer Print (PTP™) Process

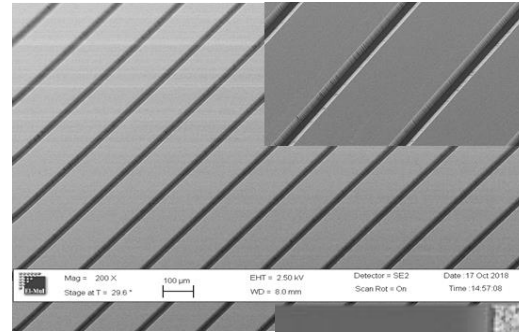
Micro pattern



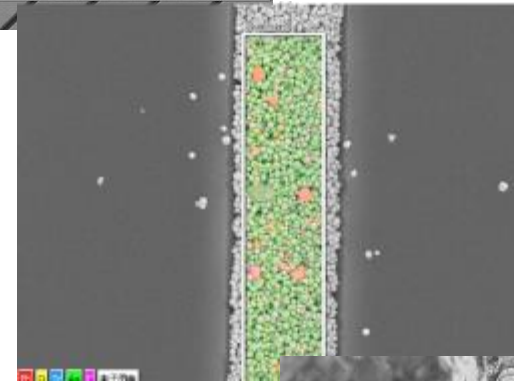
Filling paste



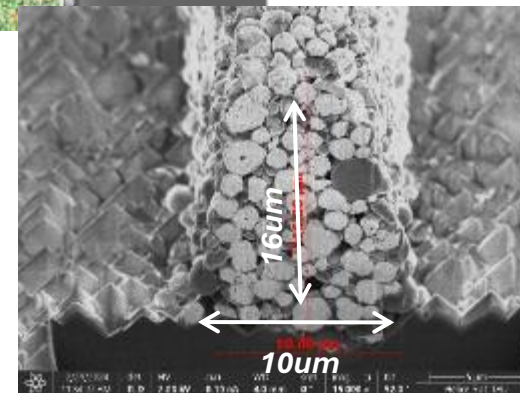
Laser Transfer



- ✓ *Meshless*
- ✓ *High Density Pattern*
- ✓ *Multiple uses*
- ✓ *Low cost*



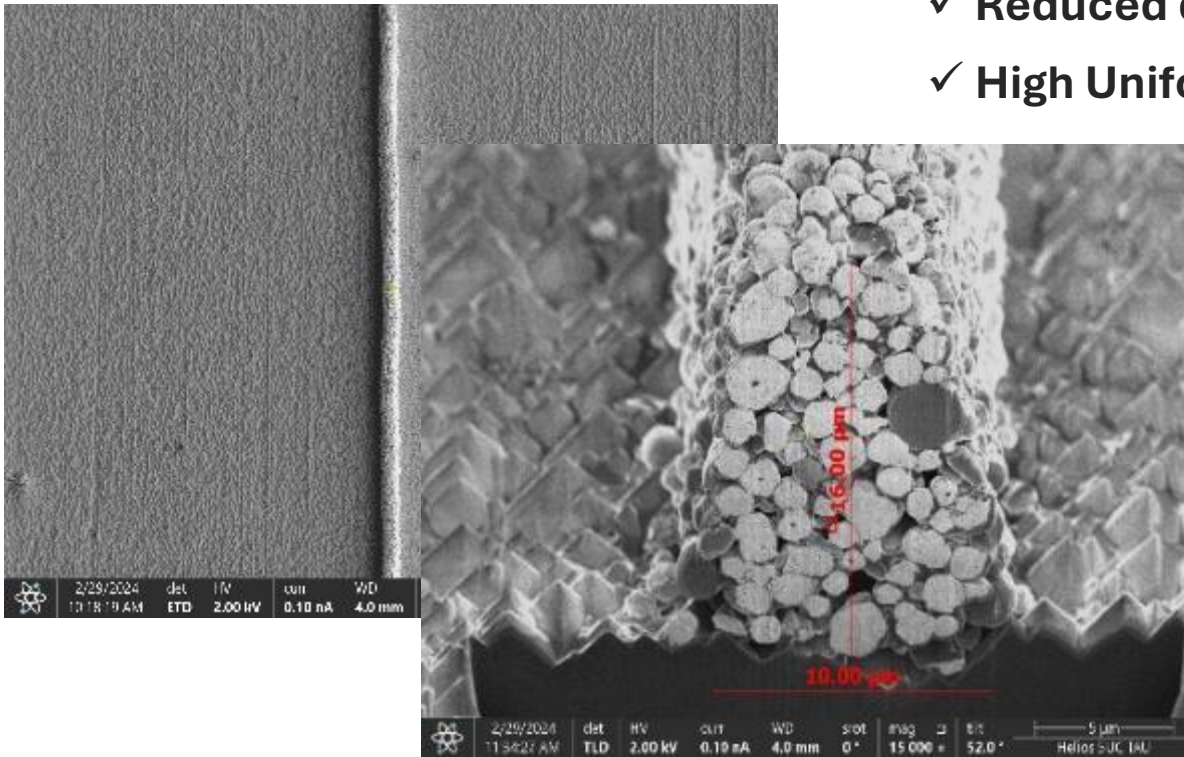
- ✓ *High Viscosity Paste*
- ✓ *Standard Pastes*



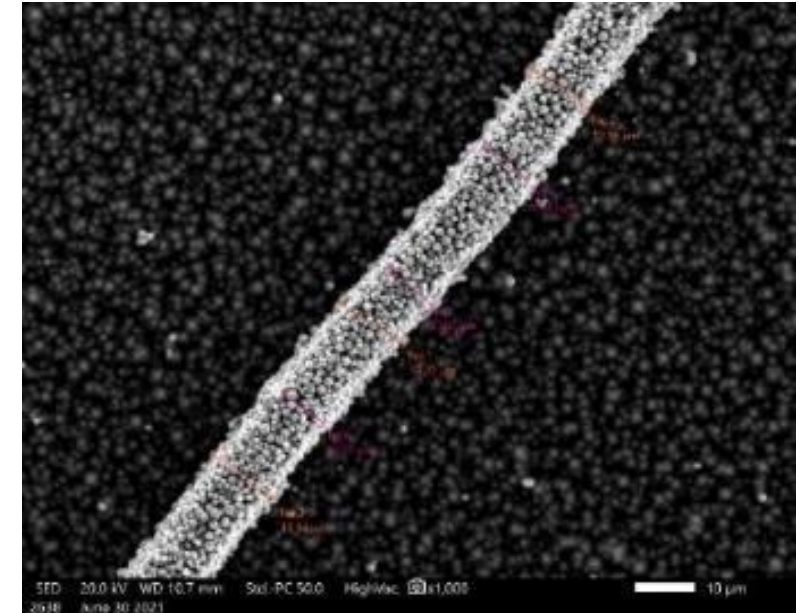
- ✓ *Non-Contact*
- ✓ *Fine line*
- ✓ *High Aspect Ratio*
- ✓ *350HZ Scanning*
- ✓ *Dynamic Printing*

Pattern Transfer Print – Capabilities

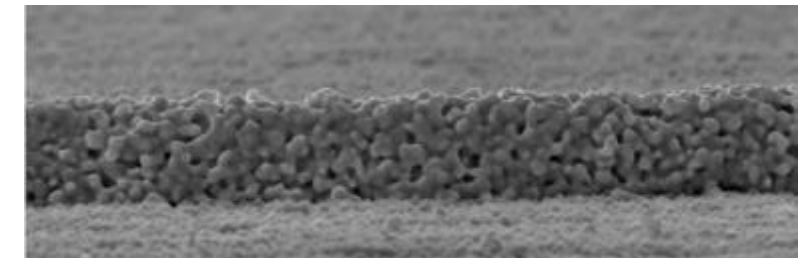
- ✓ High Yield
- ✓ Reduced debris
- ✓ High Uniformity



10um width X 16um height finger
Ag paste on Si wafer

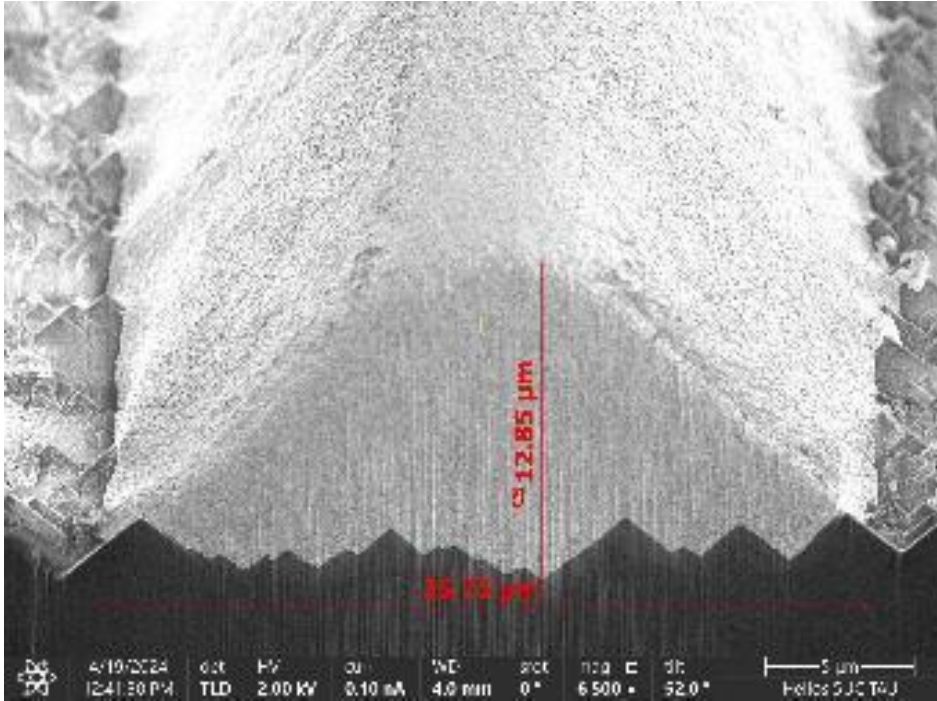


14um width X 12um height finger

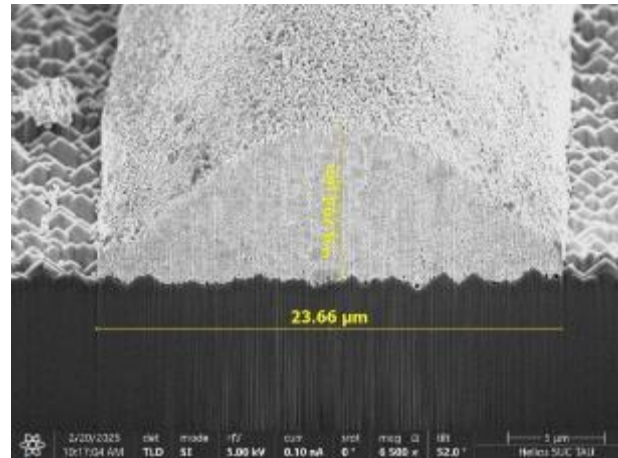


uniform shallow height of 5um

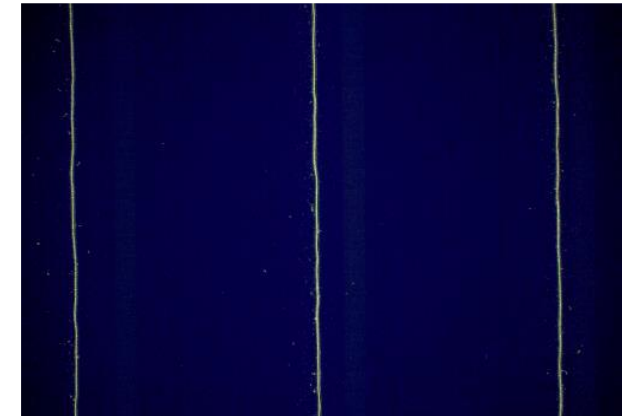
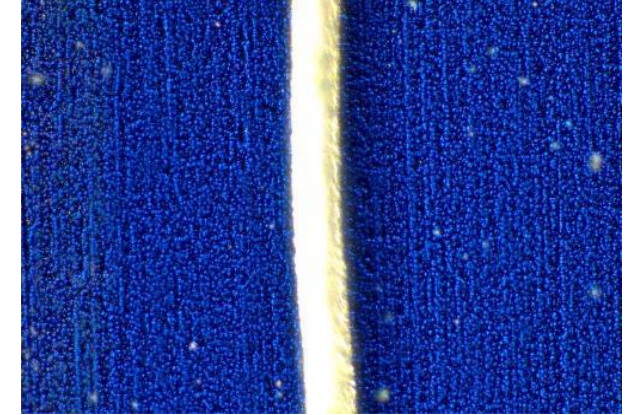
Pattern Transfer Print – Paste Versatility



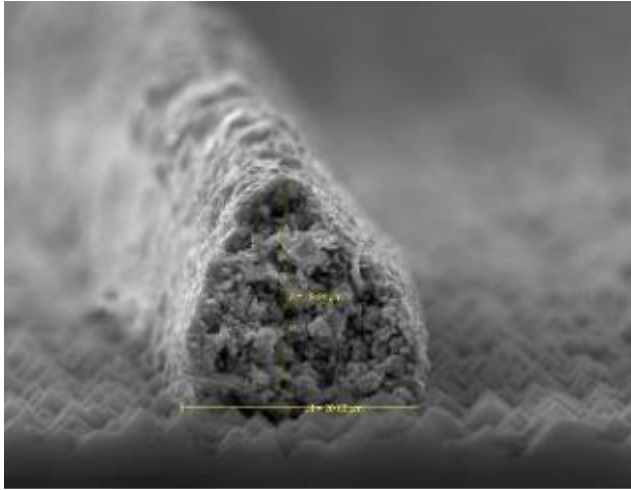
22μm wide low temperature nano-Ag paste on Si wafer



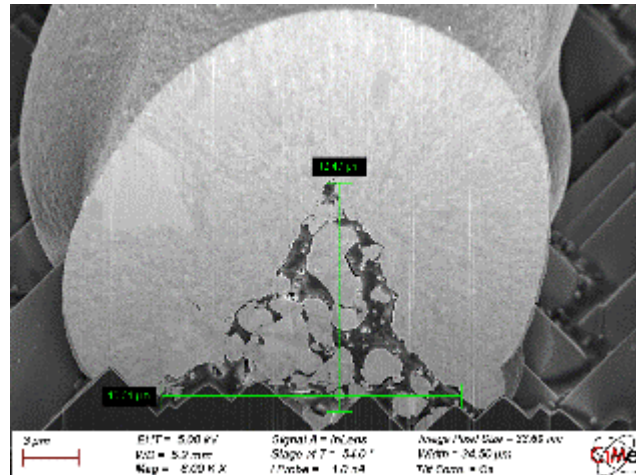
24μm wide low temperature nano-Cu paste



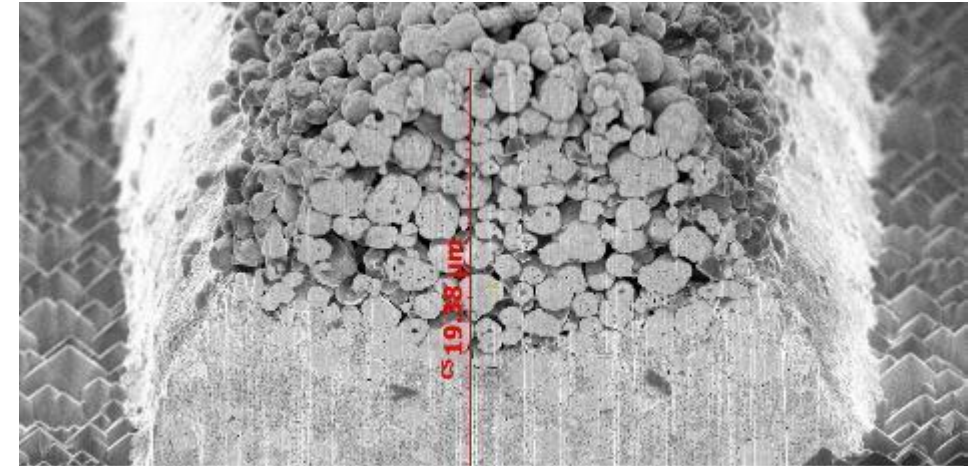
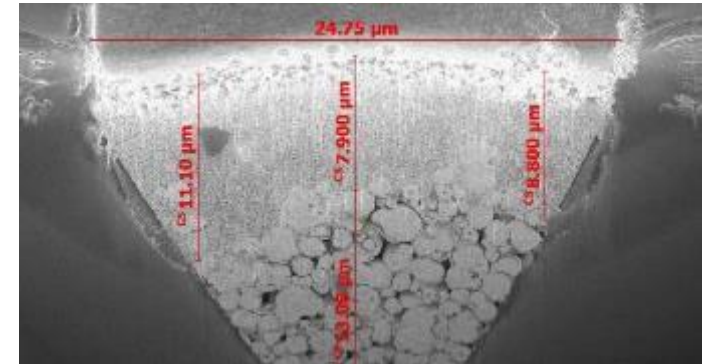
Pattern Transfer Print – Advanced Capabilities



HJT (Heterojunction Technology) paste maintain original trench triangular cross section. Reduce shadow lost by internal reflections



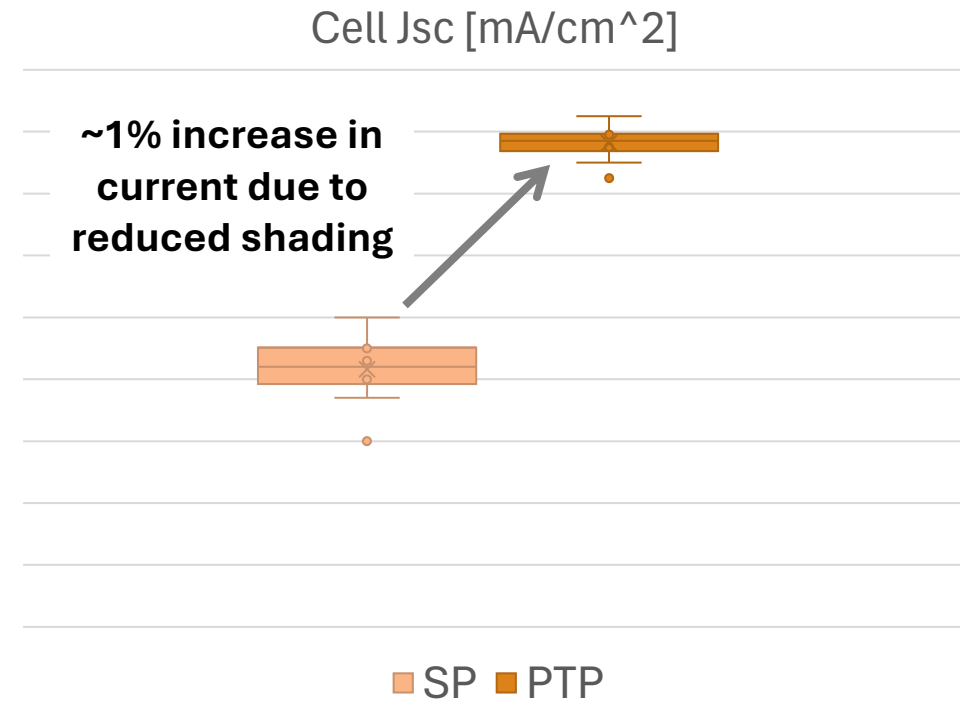
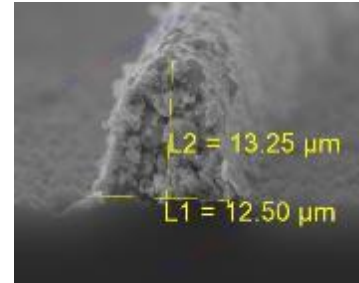
PTP copper seed layer printing followed by copper electroplating (Joint CSEM project)



Single print, self-aligned multi-layered pastes. Micro Ag & Nano Ag

PTP PV Performances – Cells Production

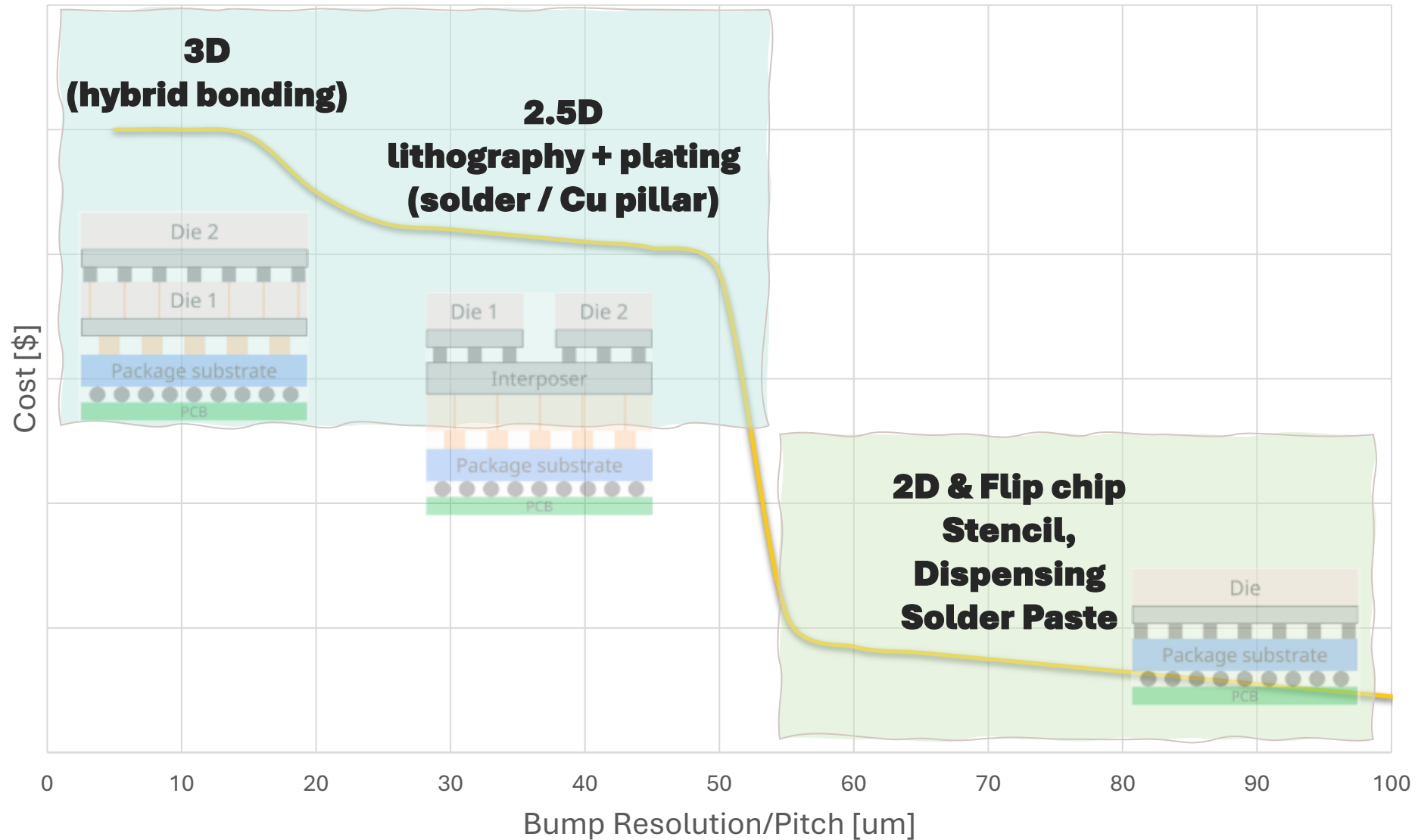
- ~0.2% absolute efficiency gain
- Significant Ag paste saving (~20%)



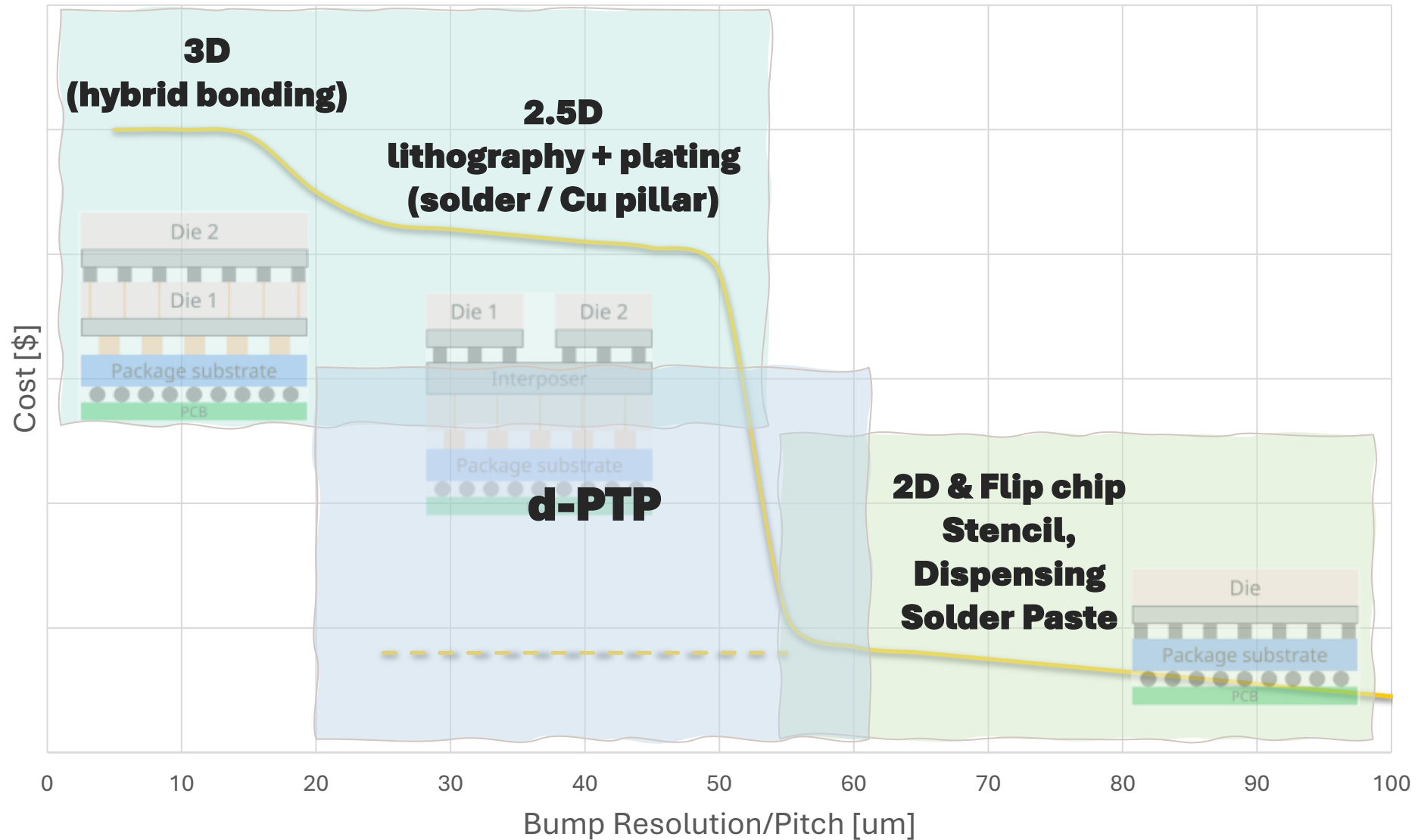
Printing Technologies in Electronics Market

	Stencil/Screen Print	Inkjet	d-PTP	EHD (e-jet)
Digital	x	✓	✓	✓
Analogue	✓	x	✓	x
Non-Contact	x	✓	✓	✓
High viscosity pastes (>>100kCP)	✓	x	✓	x
Standard inks/pastes	✓	✓	✓	x only Nano
Aspect ratio	~0.5	<0.5	1	<0.5
Resolution	>50um	<100um	<20um	<1um
Throughput	~8 sec per PCB	Med-Low	High >1000 bumps/sec	Low

Advanced Packaging Challenges

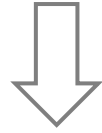


Digital PTP™ - Advanced Packaging Bumping Solution

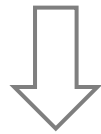


Digital-PTP™ Process – Bumps Application

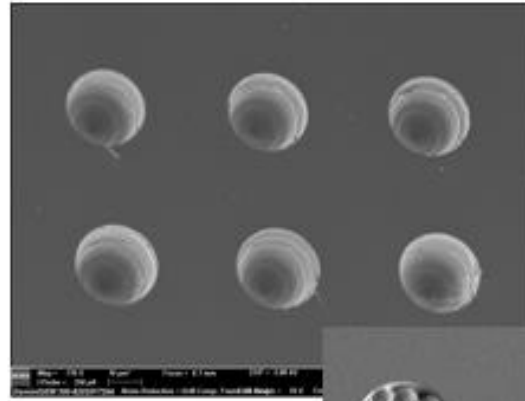
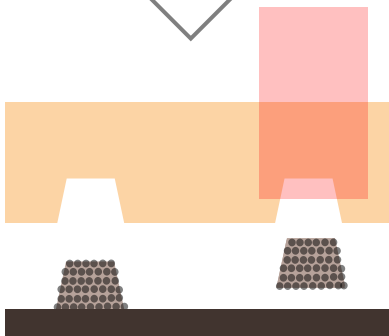
Micro Bump pattern



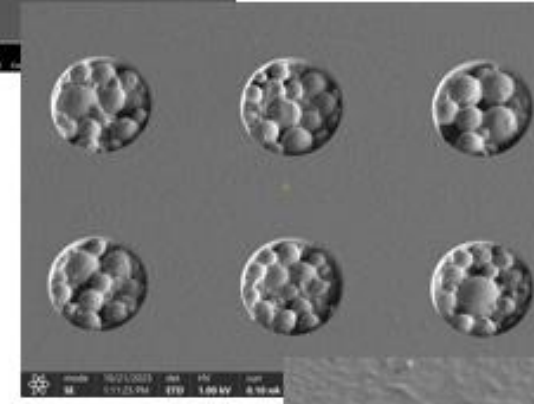
Filling Solder paste



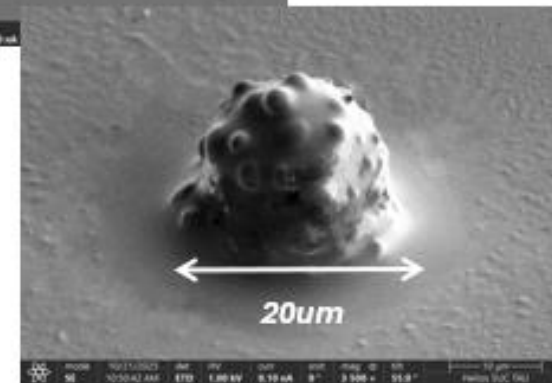
Laser Transfer



- ✓ *Ultra dense pitch*
- ✓ *Multiple uses*
- ✓ *Low cost*

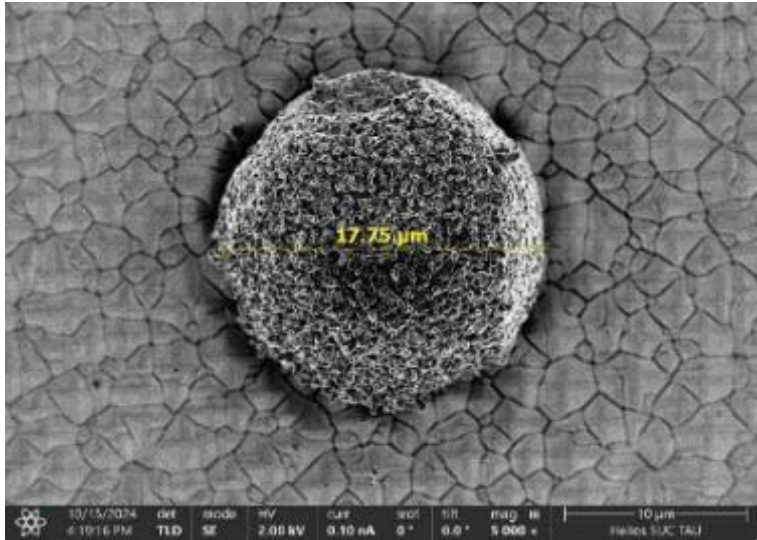


- ✓ *T5-T9 solder paste*
- ✓ *Any alloy*



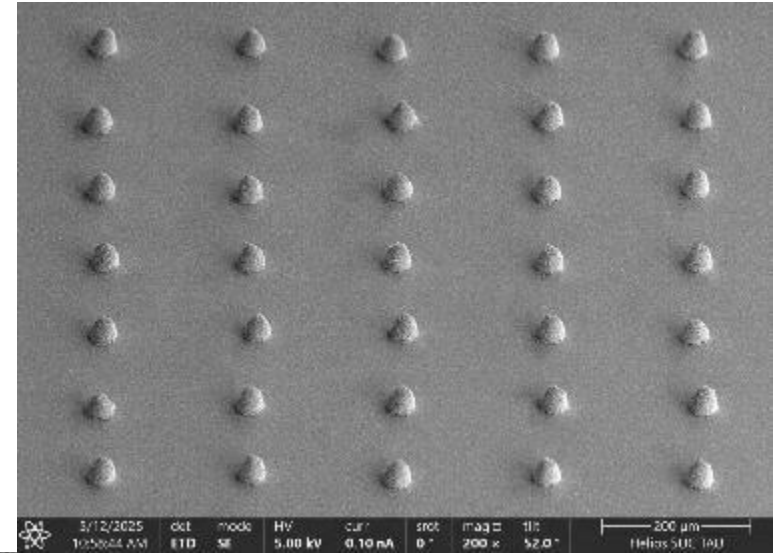
- ✓ *Non-Contact*
- ✓ *High Resolution*
- ✓ *High Aspect Ratio*
- ✓ *Dynamic/Digital*

Pattern Transfer Print – Bump Printing Capabilities

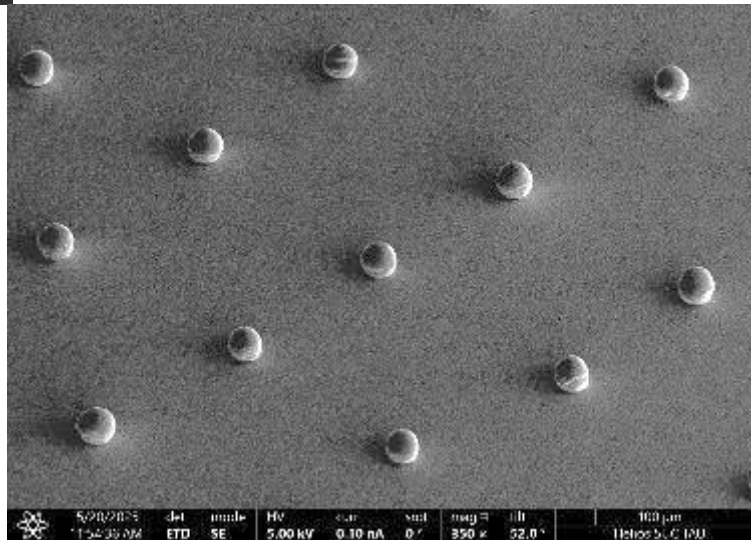


Nano Ag Paste 17um diameter bump

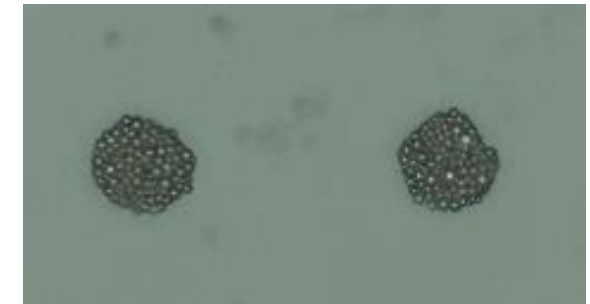
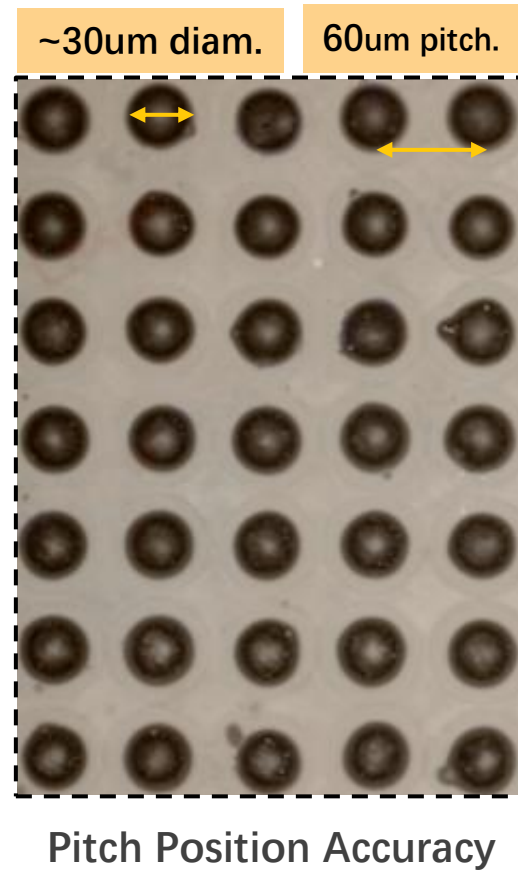
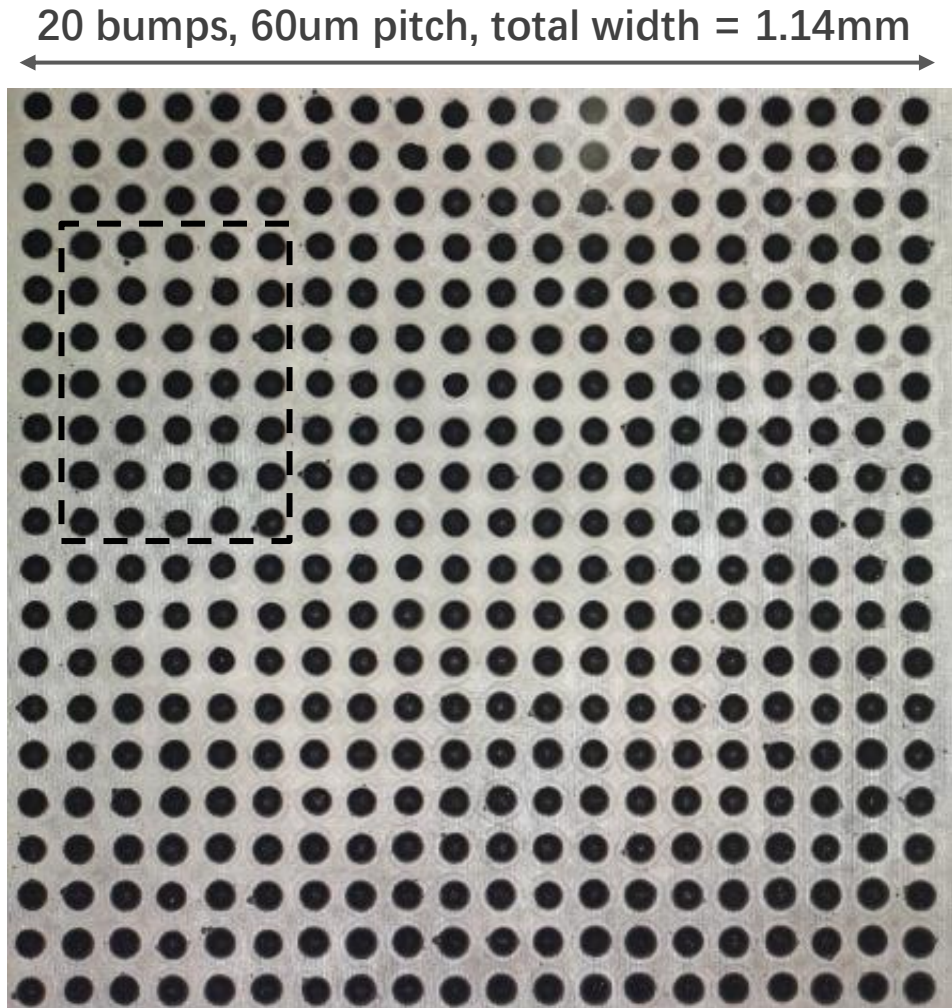
25um Solder (SAC305) bump after reflow



Array of Ag paste bumps (35um X 30um)

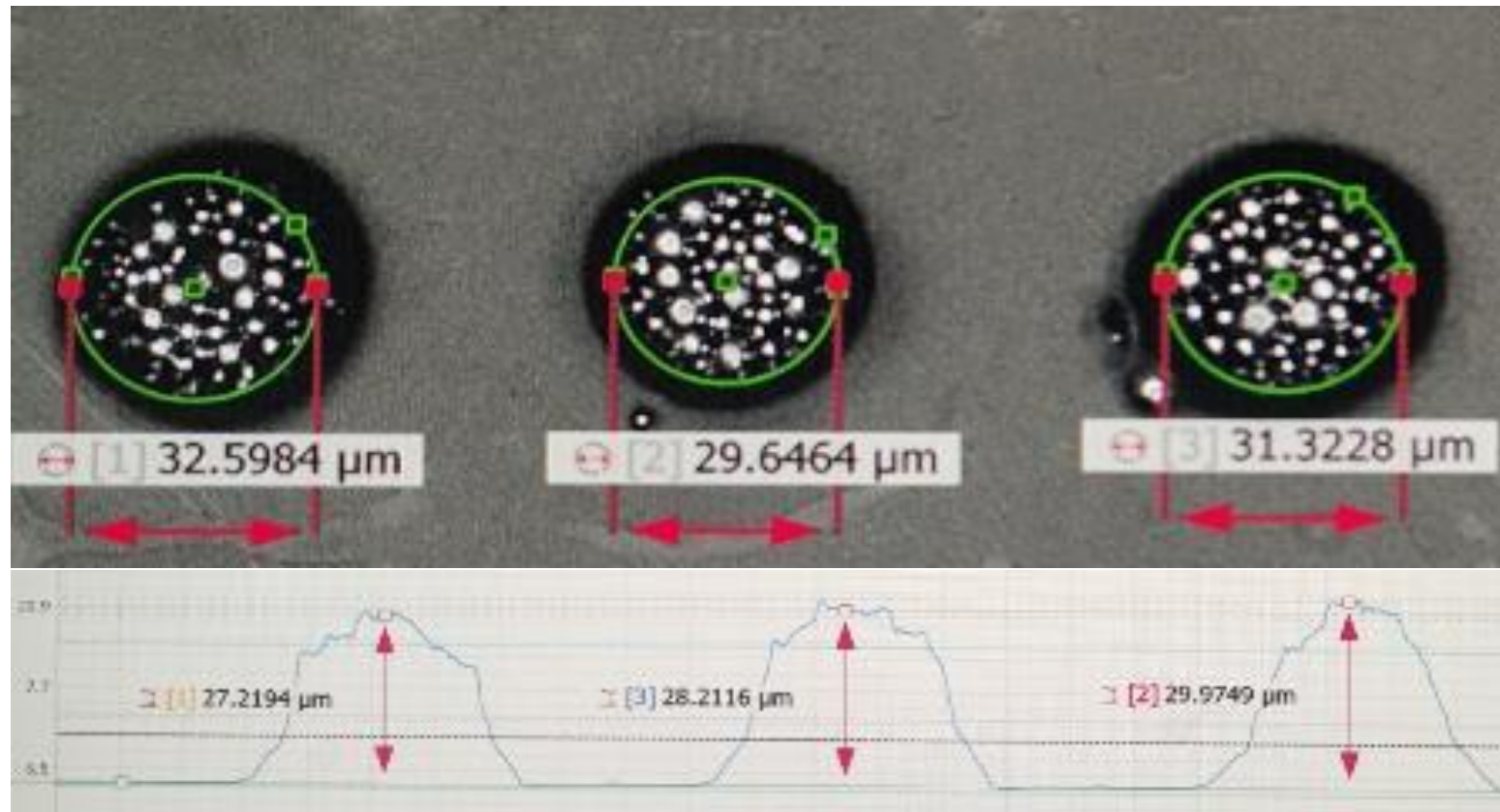


Pattern Transfer Print – Full Chip Printing



Pattern Transfer Print – Uniformity Printing

- Solder Paste Printing - Height and Volume uniformity
- Diameter 29.5-32.5 μm
- Height 27-30 μm

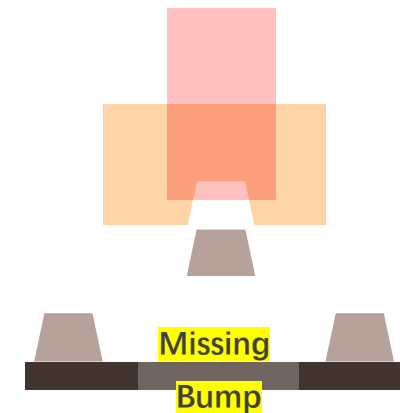


R&D & small-scale bumping tool

- Compatible with **all wafer** format (12'', 8'', 6'') & **single chips** printing
- High **resolution** bumping → down to **20um**.
- Bump **pitch** down to **40um**
- Volume **control** → high **uniformity**
- High **viscosity** pastes → >100kcp
 - various material (**all solder alloy**, Ag, Cu, Al, etc.).
- High Position **accuracy** → +/-3um
- Fully **digital** mode – ‘**Maskless**’
Up to 100 bumps/sec
- **Noncontact** print technology
 - Support **re-work/repair**
 - Support **bump-on-bump**
 - Support **solder alloy print on pillars**

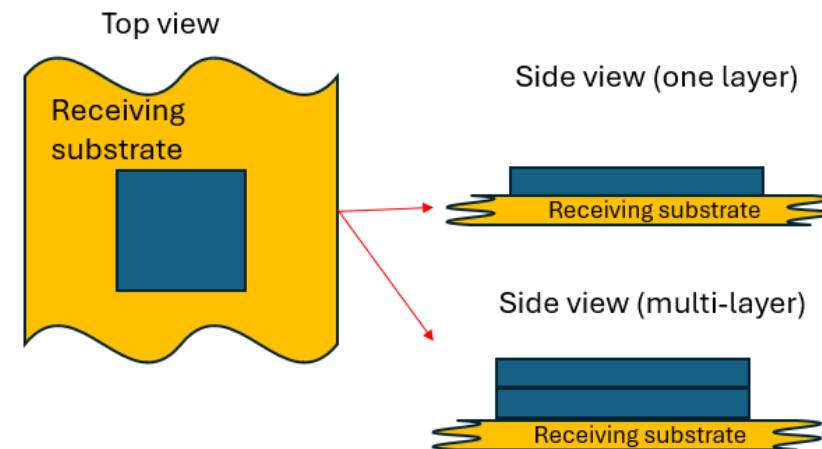
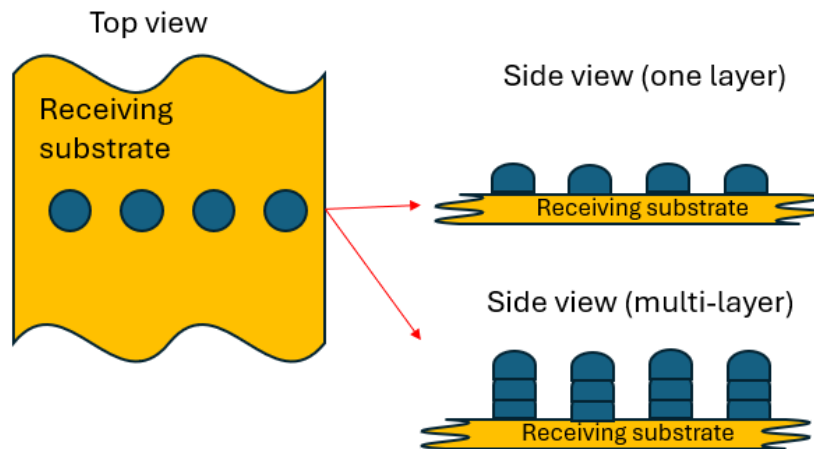


Digital
Repair/Re-work
By PTP

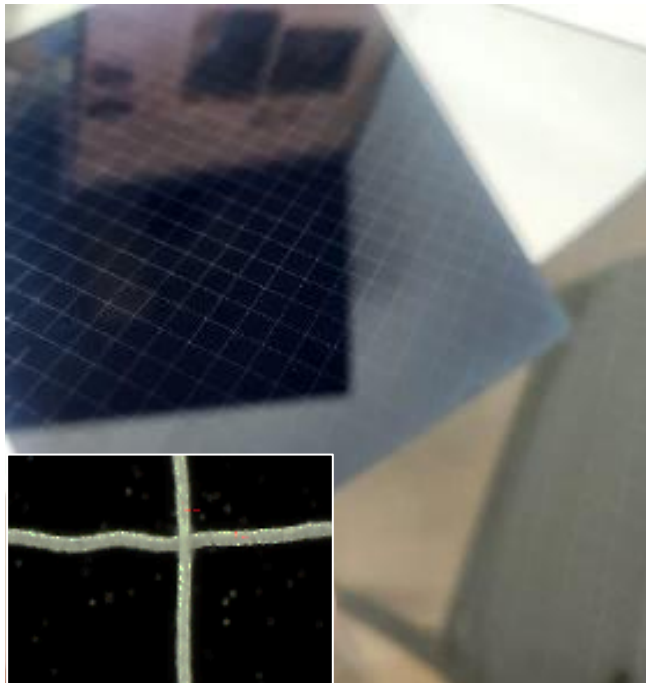


- By using Print-on-print (non-contact wet on wet) capability of the PTP (Pattern Transfer Print), double/'triple' volume can be easily applied to control the amount of solder required for small components and large components.

- For increased aspect ratio
- For different paste combinations

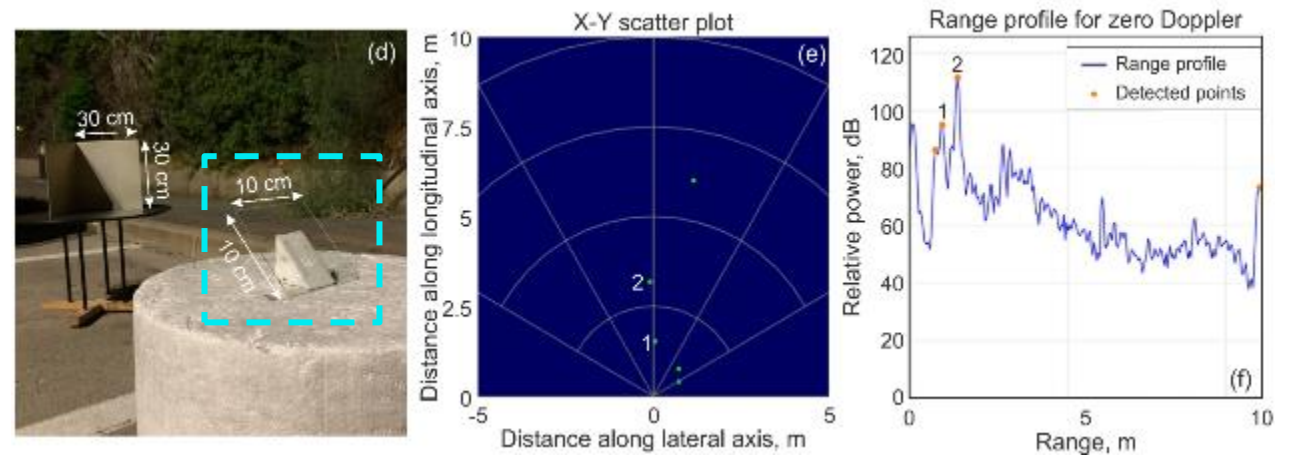
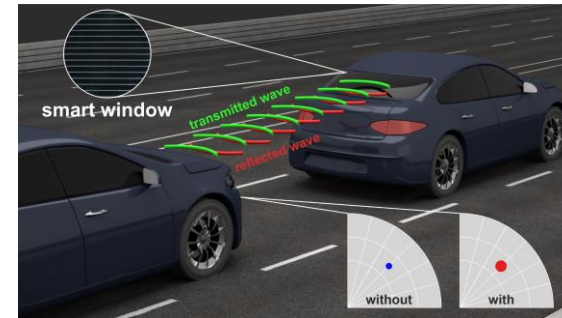


- Transparent heater



Transparent Heater Ag paste Grid

- Transparent antenna and reflector



Transparent Antenna printed by PTP on Glass
(Cooperation with Tel-Aviv, Riga Technical & Chernivtsi National Universities)

Exploring new application - SMT (surface mount technology)

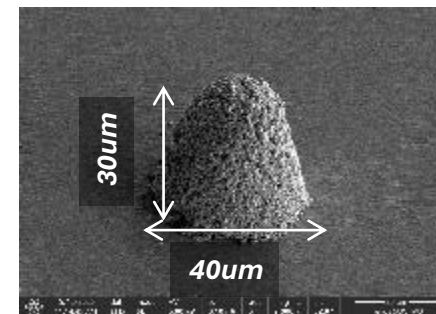
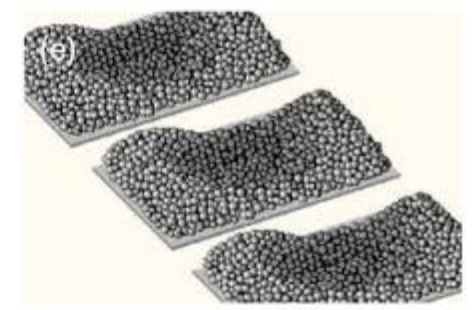
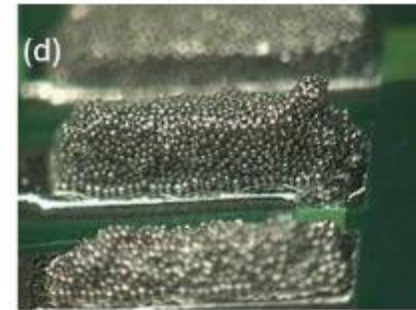
- High **resolution** solder 'dot' printing → from 50um (2 mil) to 200um (8 mil)
- High aspect ratio → 0.5 up to 1
- Precise Volume **control** → high pads **uniformity**
 - No 'scavenged'/'scooping' defects
- **Noncontact** print technology
 - Print-on-print
 - **No separation defects** ('dog ear'/'peaking')
 - **No sealing defects** ('bridging')
- ~1000 dots per second (>100 times faster than dispensing)
- Full cycle time of few seconds per board (competitive with standard stencil SMT printers)

Cooperation with UBE
(UV B-stage Epoxy)
insulating pastes
company

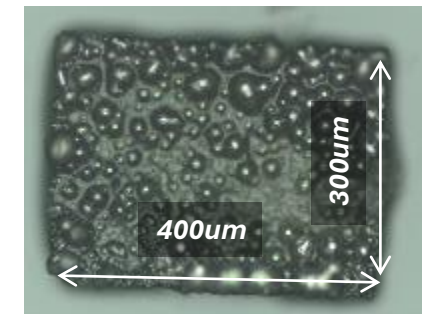


Common stencil print defects:

- (d) 'peeling' issue, known as 'dog ear' causing height non-uniformity
- (e) 'scooping' issues leading to uneven paste distribution.



40um 'dot' printed by d-PTP
for SMT



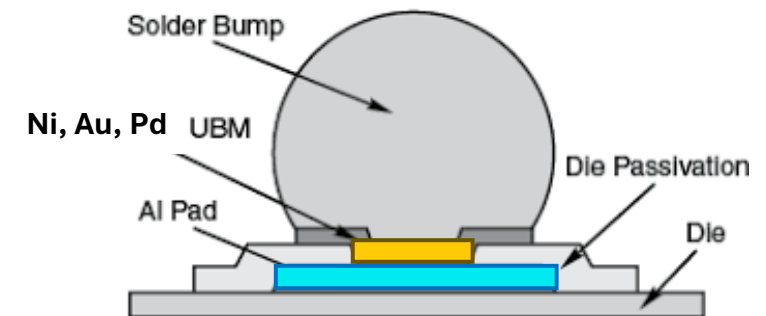
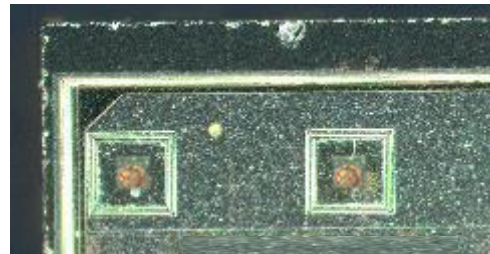
400X300um solder pad
(for 0204 components)
printed by d-PTP for SMT

Case Study – print on pad flip chip

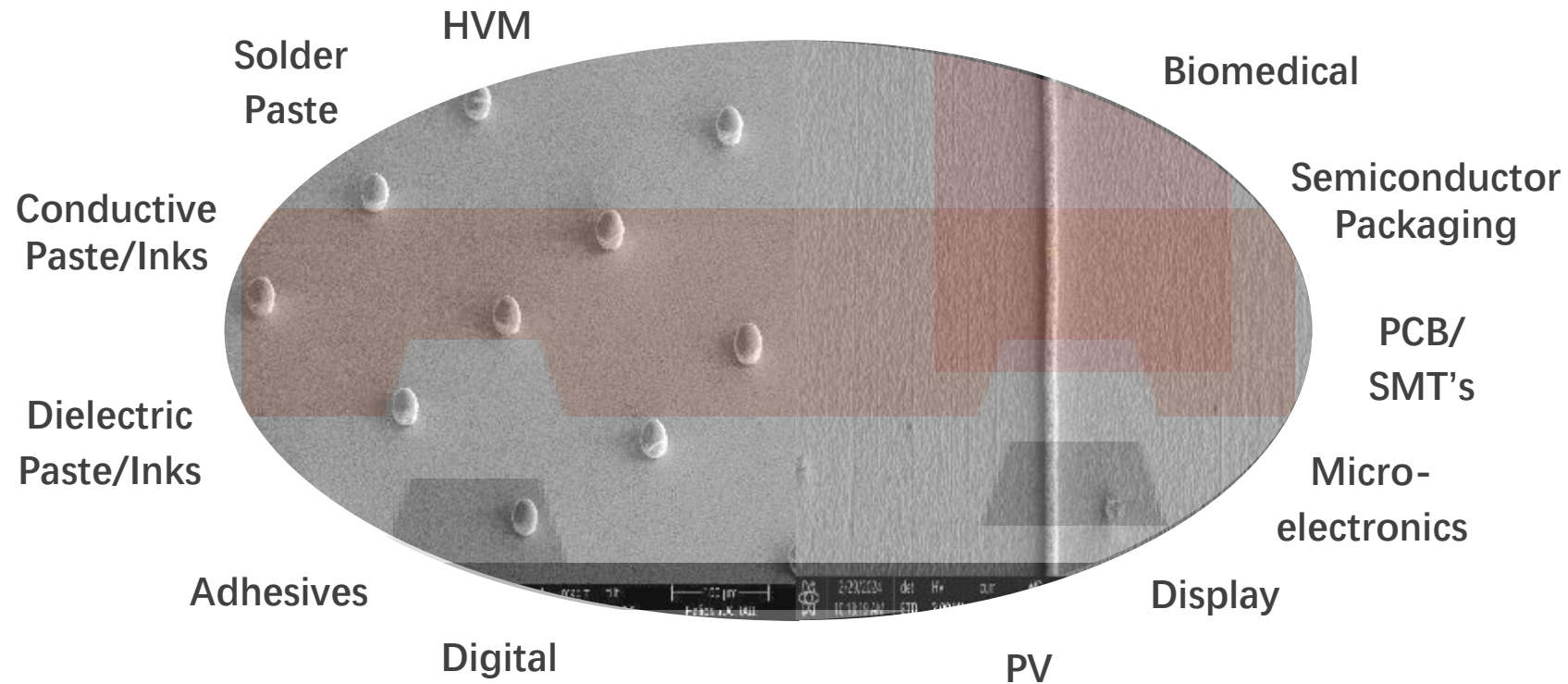
- The most common pads in the industry are from Al
- Despite the rapid oxidation of aluminum pads, a wire connection can be made, whereas a flip-chip connection is challenging due to oxidation.
- For flip-chip connection, it is necessary to coat the aluminum pad with a metallic coating that will not oxidize to support solder joint bonding

➤ Cooperation with Beckermus Technologies & Nano Chemica companies

- UBM metallic coating
- Printing solder ball on top of the UBM
- Chip packaging
- Testing the chip - shearing \ Xray \ electrical \ adhesion etc..



PTP™ - High Volume Additive Manufacturing Solution



Thanks for the Attention – Let's Cooperate!

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