

PacTech

member of nagase group

ADVANCED PACKAGING EQUIPMENT AND
WAFER LEVEL PACKAGING SERVICES

Next generation advanced packaging using innovative laser assisted bonding equipment

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October 9th – 10th | 2023

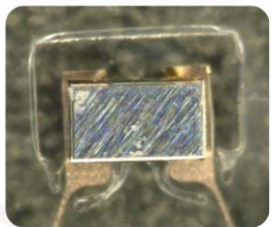
PHOTONICS DAYS
Berlin Brandenburg



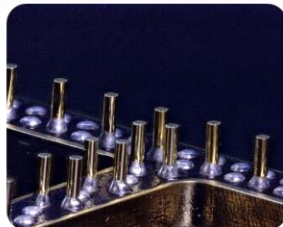
innovationconference

- Motivation & Introduction
- Advantages of Laser Bonding
- Laser Assisted Placement Technology (Laplace)
 - Process Modes "LAB" & "LAR"
 - Explanation & Applications Laser Assisted Reflow "LAR"
- Laser Assisted Solder Placement Technology (SB²)
 - Process Mode "Solder Ball Jetting" for SMT
 - Explanation & Application examples

Mini-LED



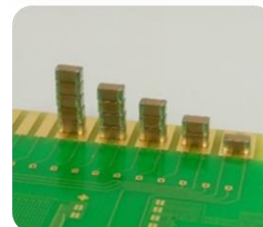
Pin-Bonding



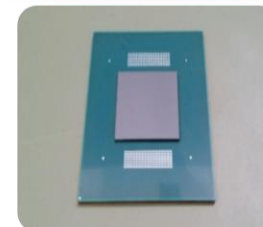
FC-BGA Package on Flex



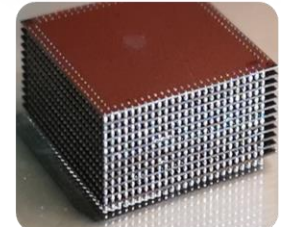
SMD-stack




CPU on Interposer



3D Chip Stack



- oven reflow processes, wave-soldering or thermo-compression bonding (TCB) methods are dominant assembly processes for manufacturing of semiconductor packages
- conventional interconnection technologies face more and more limitations due to increasing miniaturization, the integration of photonic devices or exotic material combination
 - shifting and warpage due to massive heat and vertical force
 - damaging of heat sensitive luminescence covers/films by high thermal energy
 - small and sensitive pad structures lose integrity during long soldering time
 - contamination of optical components due to flux evaporation
- high energy consumption and CO2 emission of conventional mass reflow oven processes

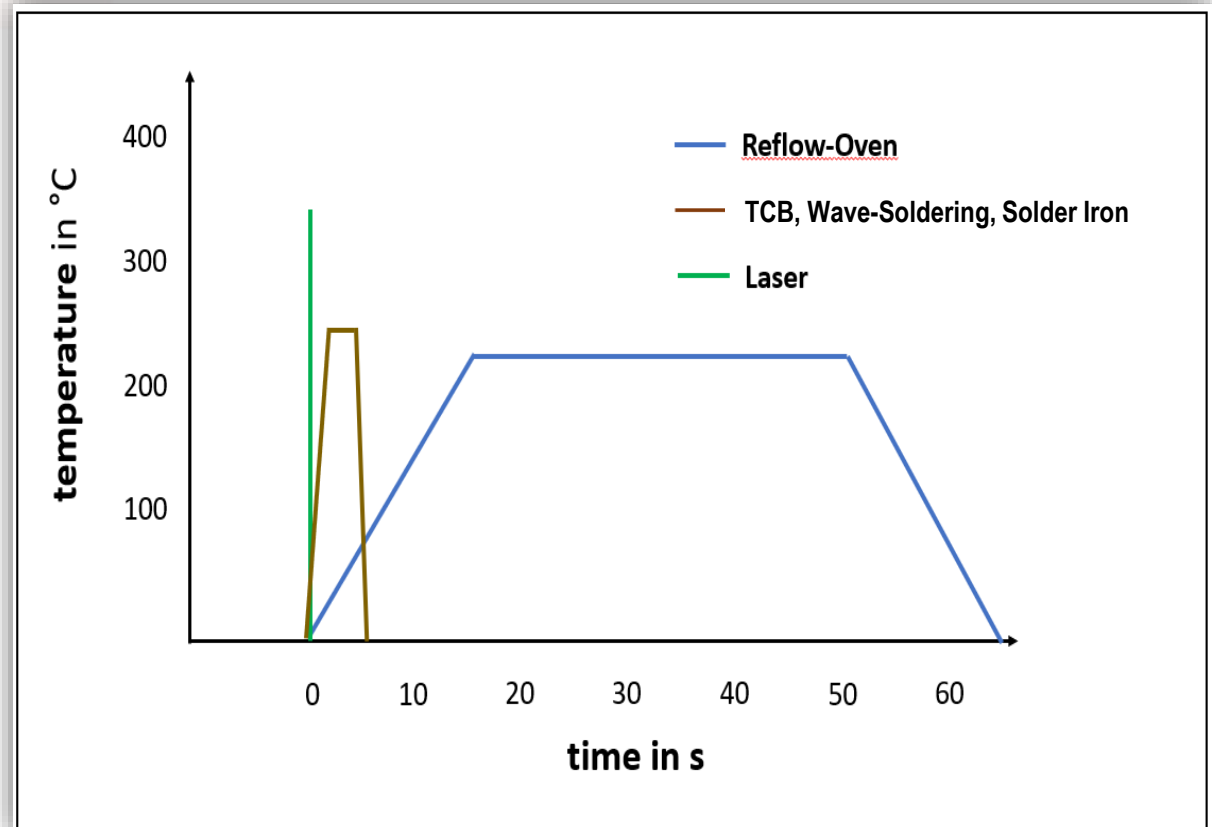


converting production lines to a laser-based reflow solution for forming bump interfaces (C4, C2), SMT contact joints or chip bonding applications

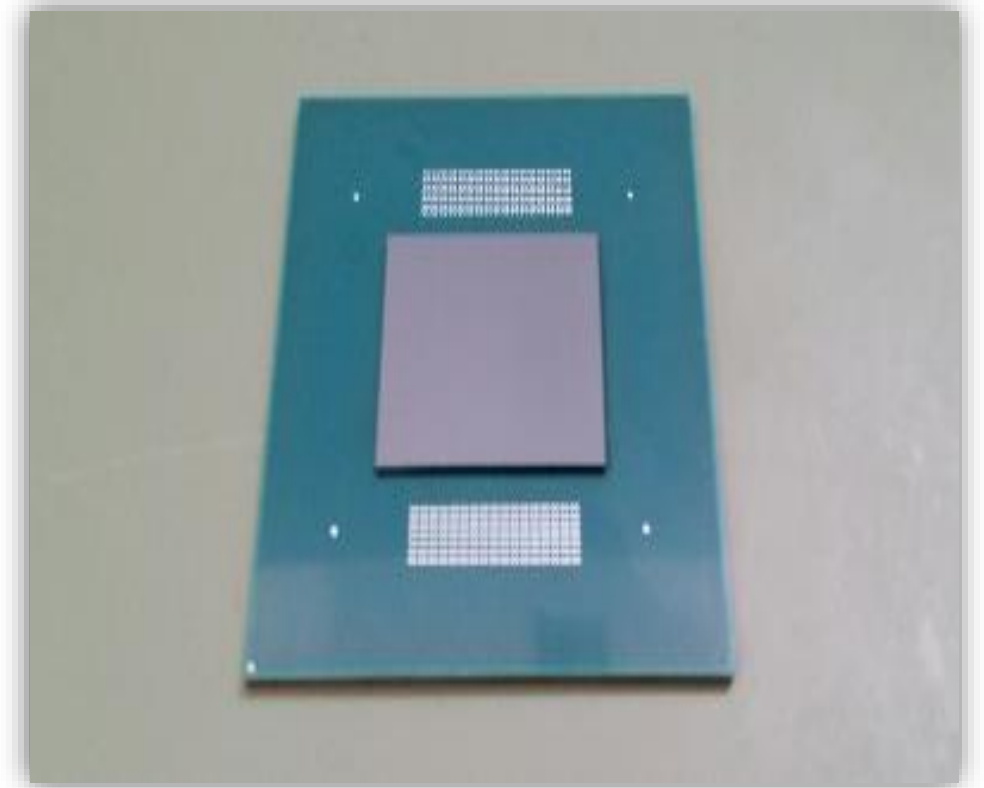
Advantages of Laser Assisted Assembly Processes

- high speed laser reflow in ms-s
- much shorter reflow time comparing to standard soldering processes
- localized and selective heating with laser
 - no thermal stress on the areas outside of bonding interface
 - lowest thermal stress on substrates interconnection
 - prevent warpage
 - bonding of heat-sensitive substrates and substrate-combinations with high CTE- mismatch
 - fluxless

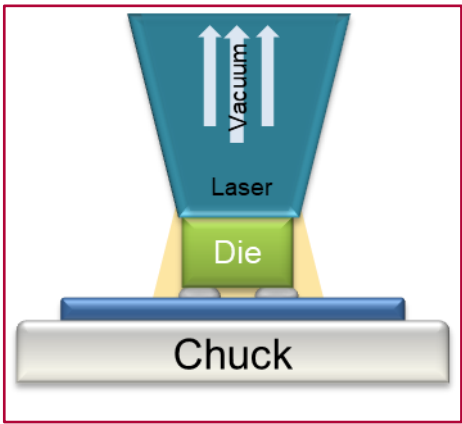
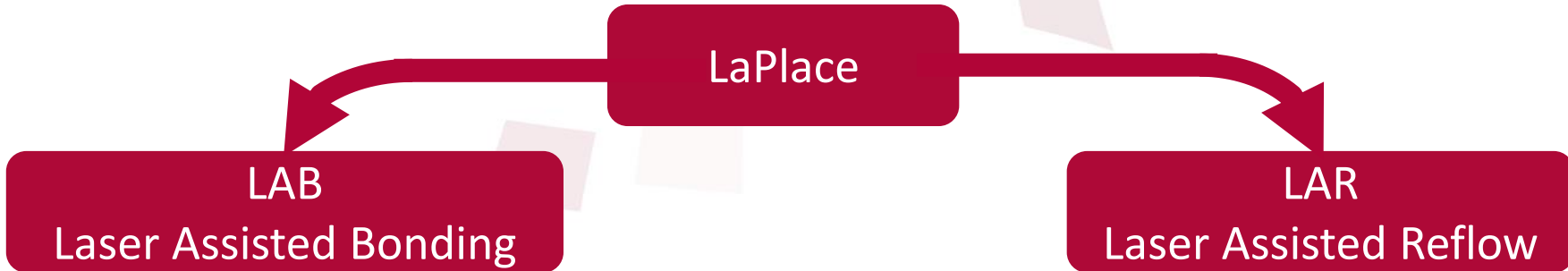
Temperature Profiles of Reflow Processes



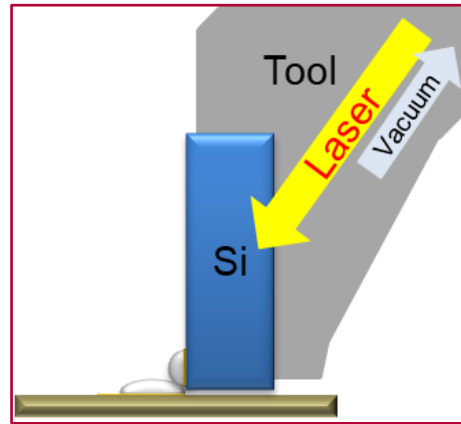
LaPlace Laser Placement



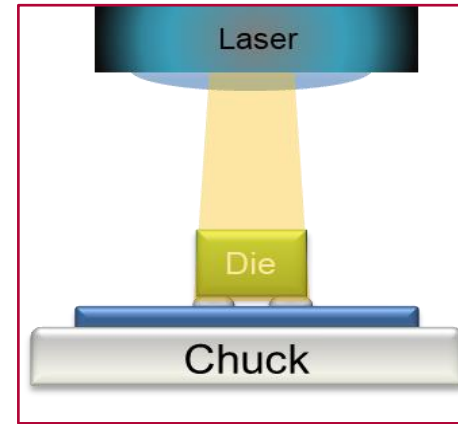
LaPlace: Process Configurations



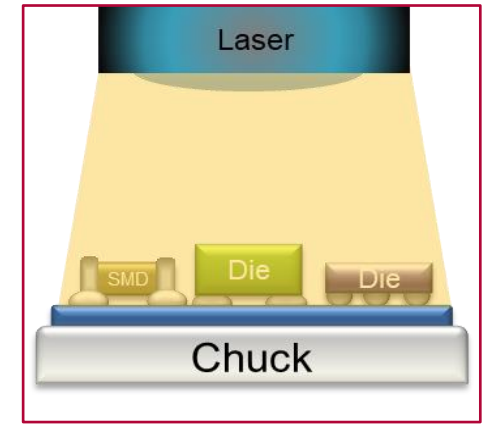
LAB



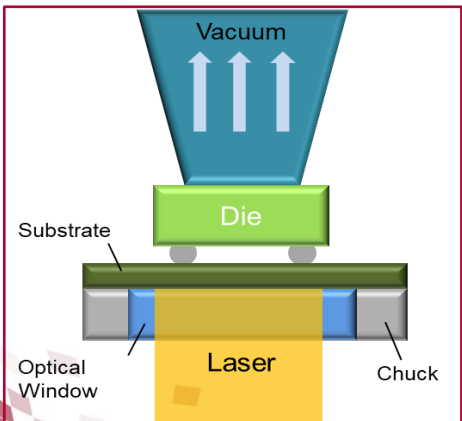
Vertical LAB



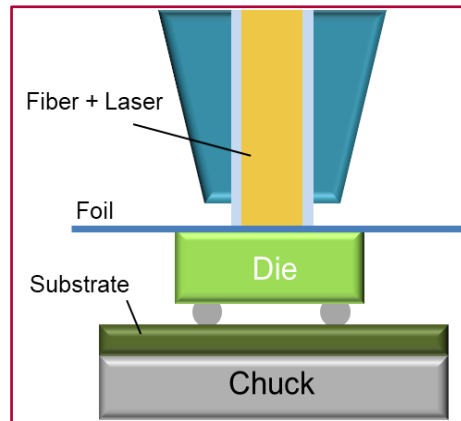
Single Die



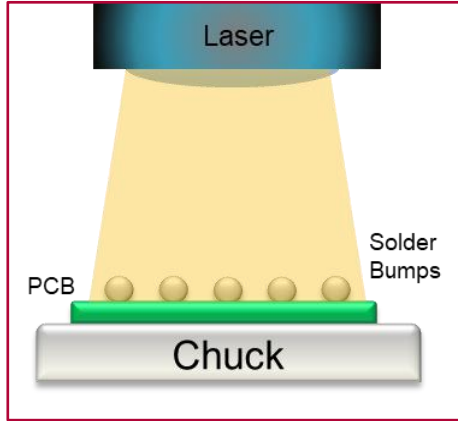
Multiple Die



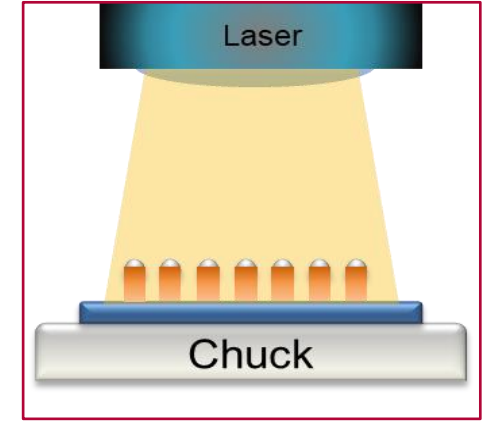
Bottom LAB



Fiber Push Connection



C4 forming



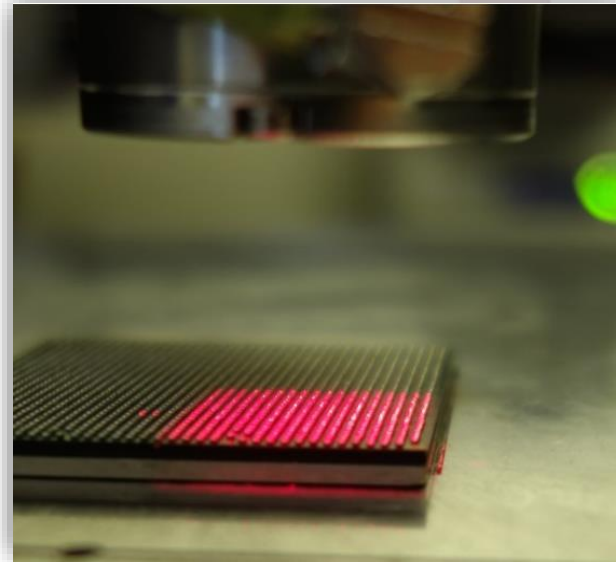
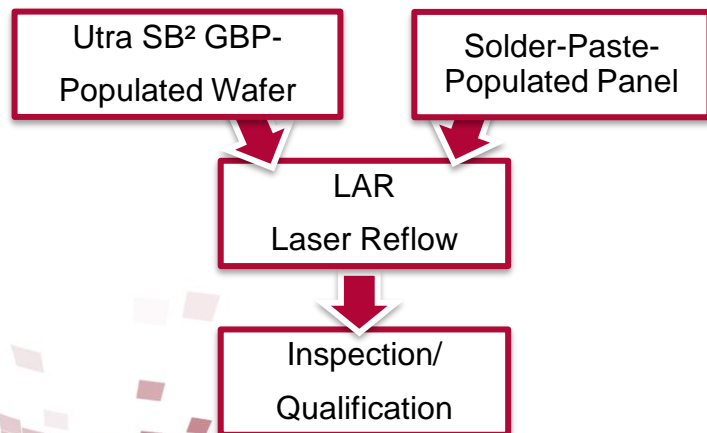
C2 forming

Laplace LAR for Wafer/Panel Level

Process introduction

LAR → Laser Assisted Reflow

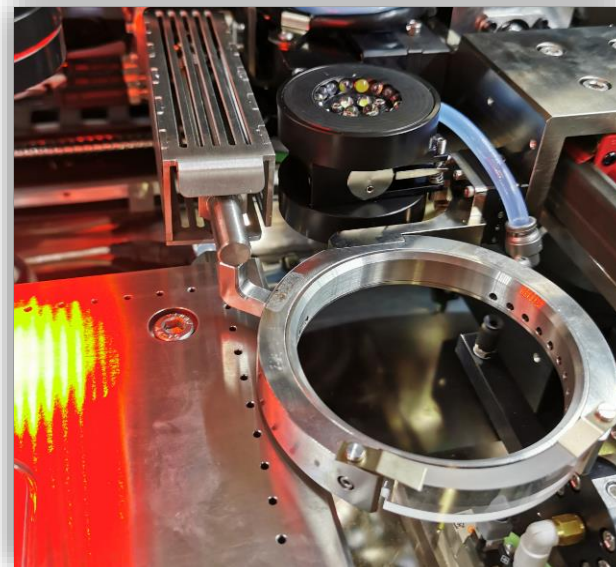
- contactless optical transfer of required energy
- NIR fiber laser
- laser power 100W-3000W
- optical and mechanical beam modulation
- flux free soldering option by integrated process-gas chamber



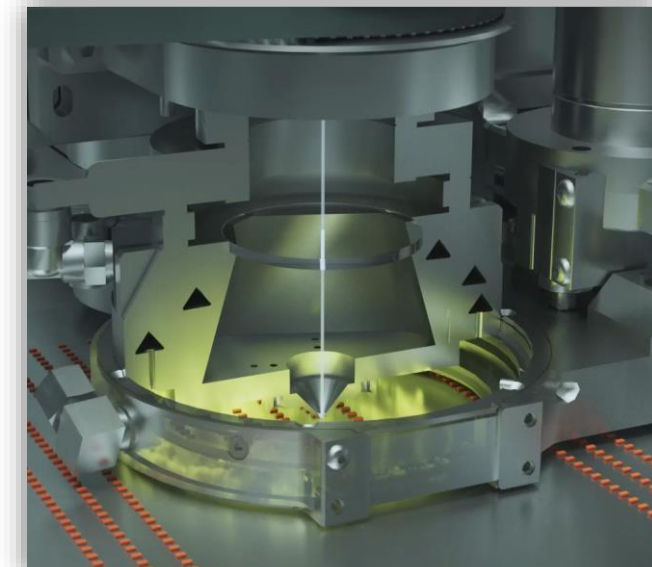
laser-reflow on BGA



FC-BGA on flex board



process gas device



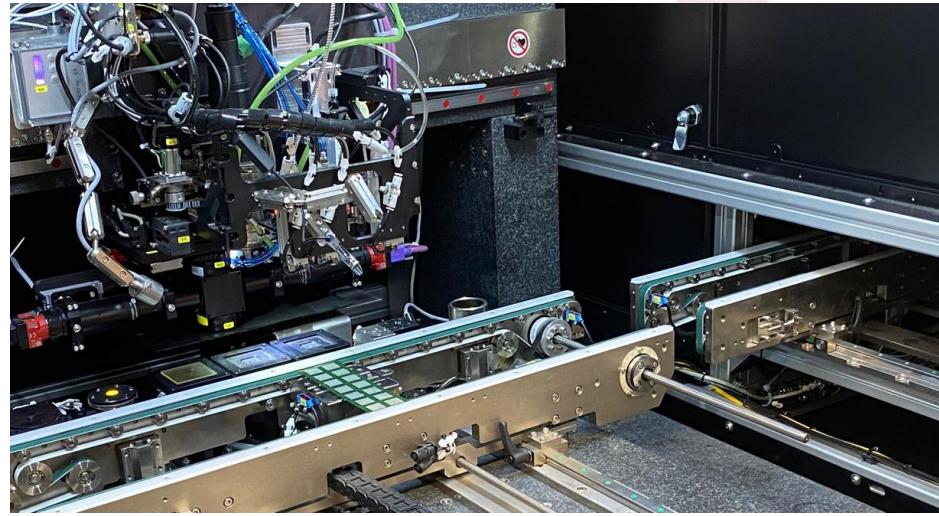
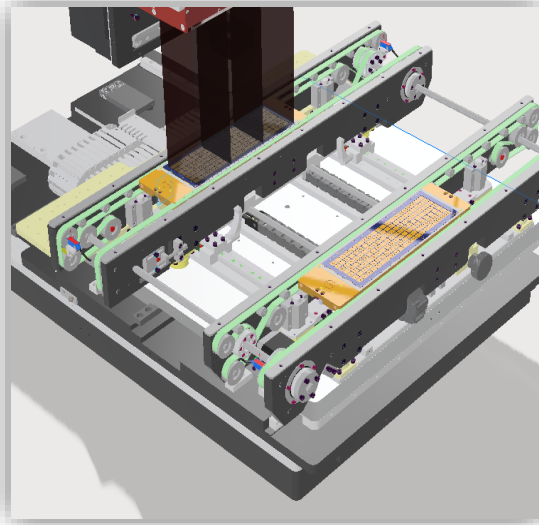
process gas laser reflow process

Laplace LAR for Wafer/Panel Level

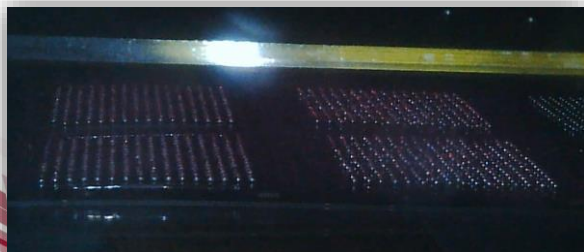
Example of CPT system platform



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- two track laser reflow system
- work space 600mm x 400 x 150mm
- beam modulation 6mm x 6mm - 45mm x 45mm (automatic adjustable)
- LAR process stepping sequence
- integrated temperature control and monitoring

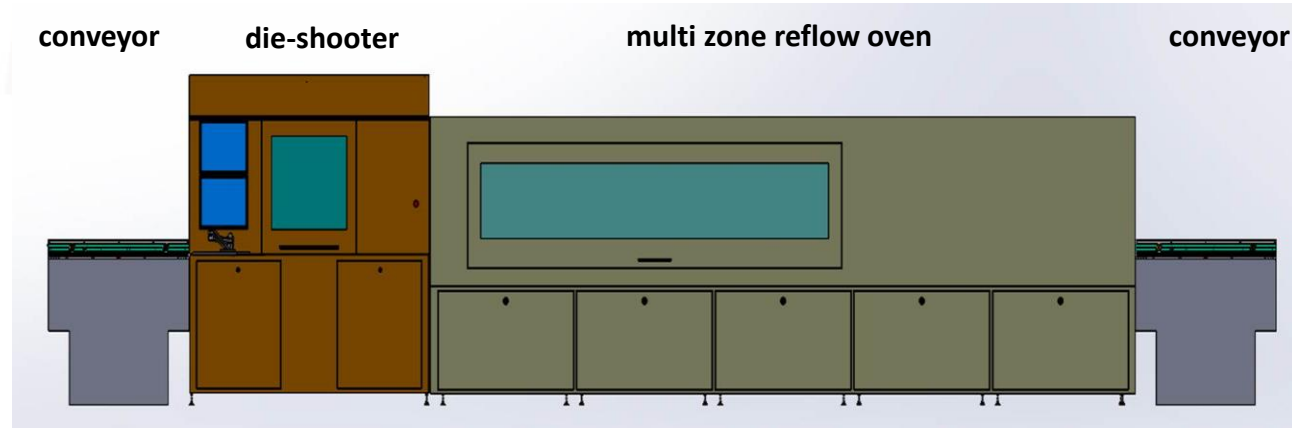


Laplace LAR & LAB for Wafer/Panel Level

Transformation of existing production lines

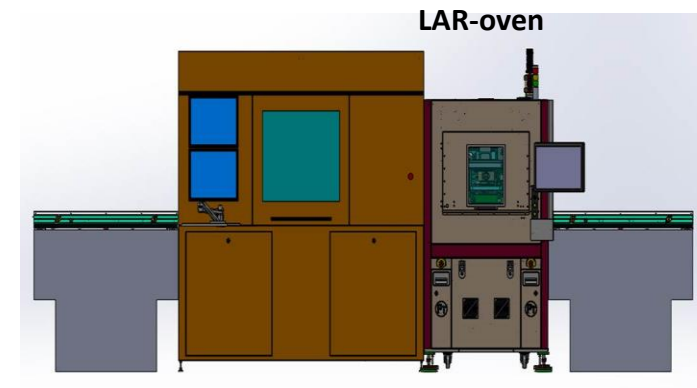
Conventional

- die-shooter with continuous multi zone reflow oven
- convection reflow principle under global N2 atmosphere
- consumption 10-15kW/h, $\approx 20 \text{ m}^3/\text{h}$
- length 8-12m



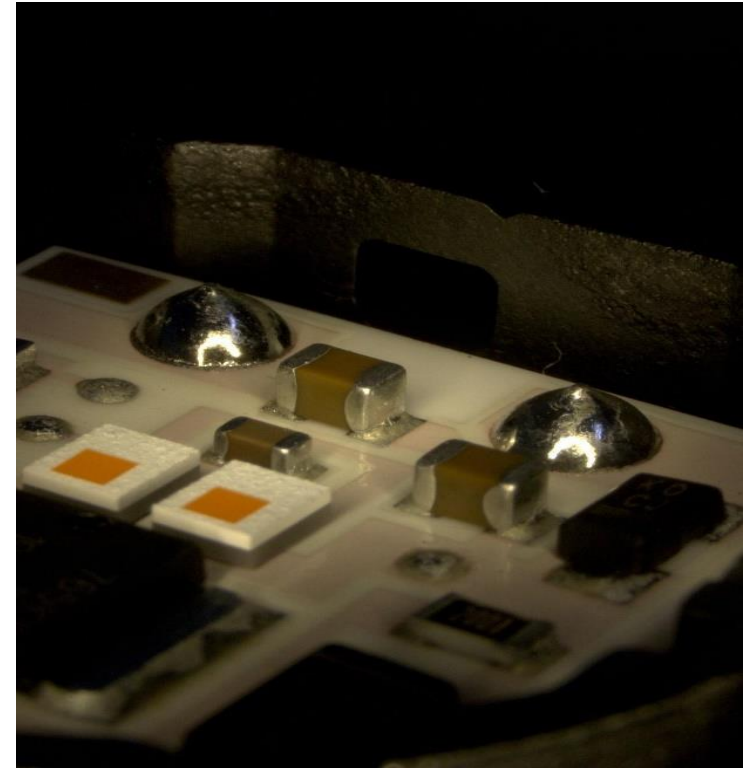
Laser Reflow

- die-shooter with LAR oven
- laser transmission reflow principle under local N2 atmosphere
- consumption 1,2-2kW, $\approx 0,6 \text{ m}^3/\text{h}$
- length 4-6m



➤ footprint reduction by min. 60%

SB²- Solder Jetting Process



SB²-Solder Ball Jetting for SMT components

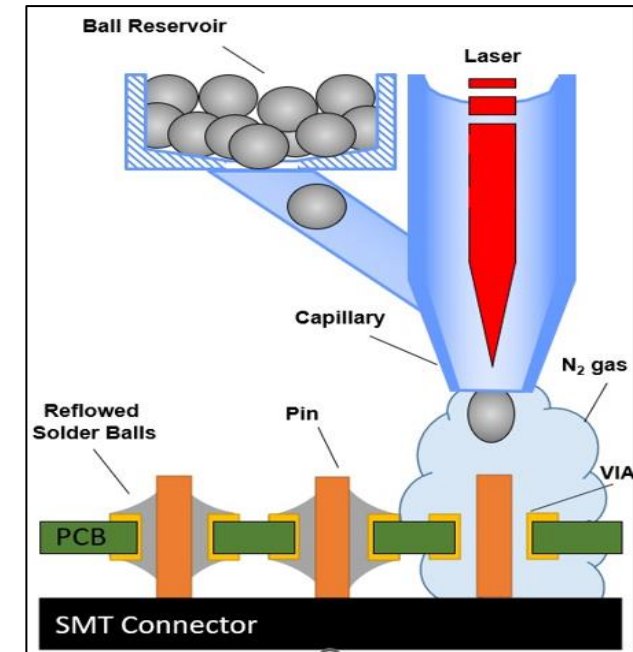
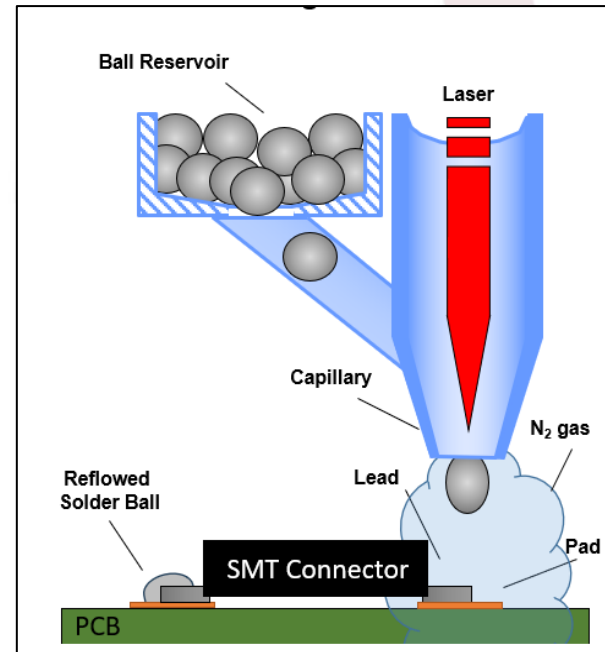
Process Introduction

SB²-Jet

- selective, contactless and fluxless soldering process with lowest reflow times (0.5ms-1s) using a NIR fiber-laser and a local nitrogen environment
- bonding of THT and SMD devices

Process Sequence

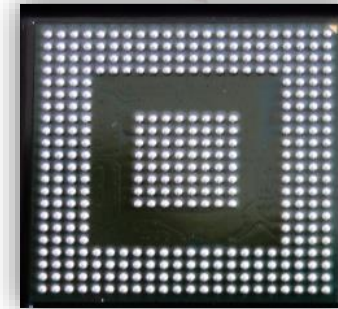
- singulation of solder spheres (range 30 μ m-2000 μ m) in bond-head
- solder sphere drops in capillary and blocks capillary hole
- triggering of solder ball presence by N₂-pressure increase
- NIR laser pulse liquifies the solder sphere which is shot out by nitrogen pressure onto the pin contact
- solder hits pin and contact surface, solidifies and forms a stable and reliable interconnection
- system moves to a subsequent bond location



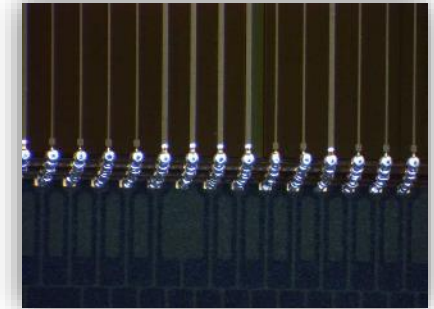
Advanced Packaging

- BGA / PCB/ Interposer
- Wafer & Flip Chips
- CSP (SIP, POP, FB-BGA, 2D, 2.5D etc.)
- Hard Disk Drive (HGA, HSA, SAA, etc.)
- SSD/Flash Drives
- Camera Modules (FF, AF, OIS)
- Home Key
- Optoelectronics/Micro-Optics/Fibers
- Mini- and μ -LEDs
- Filter- and HF-Devices (SAW, BAW)
- MEMS & Lead-Frames
- Connectors/Contact-Pins
- High power LED
- Sensors (PDC, LIDAR, X-Ray, etc.)

SMT-Packaging



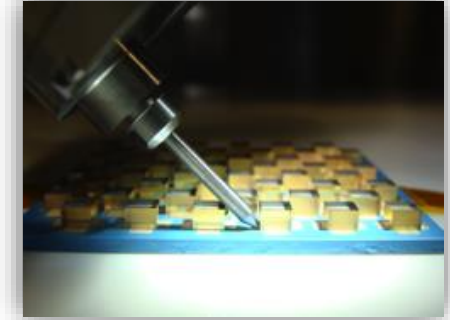
Reworked BGA



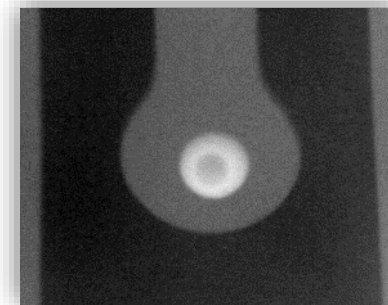
Solder stacking on SSD HD



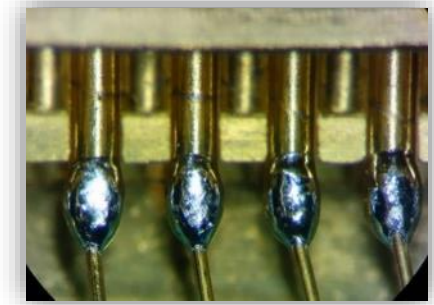
Camera module



Solder jetting for microoptics



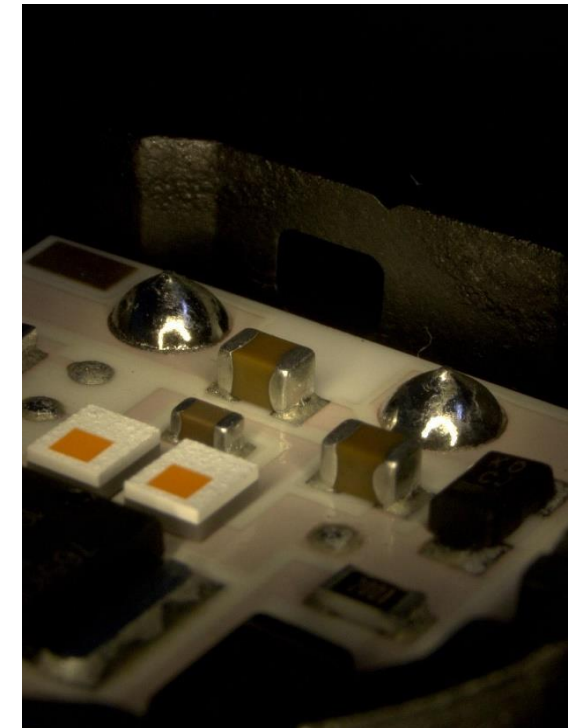
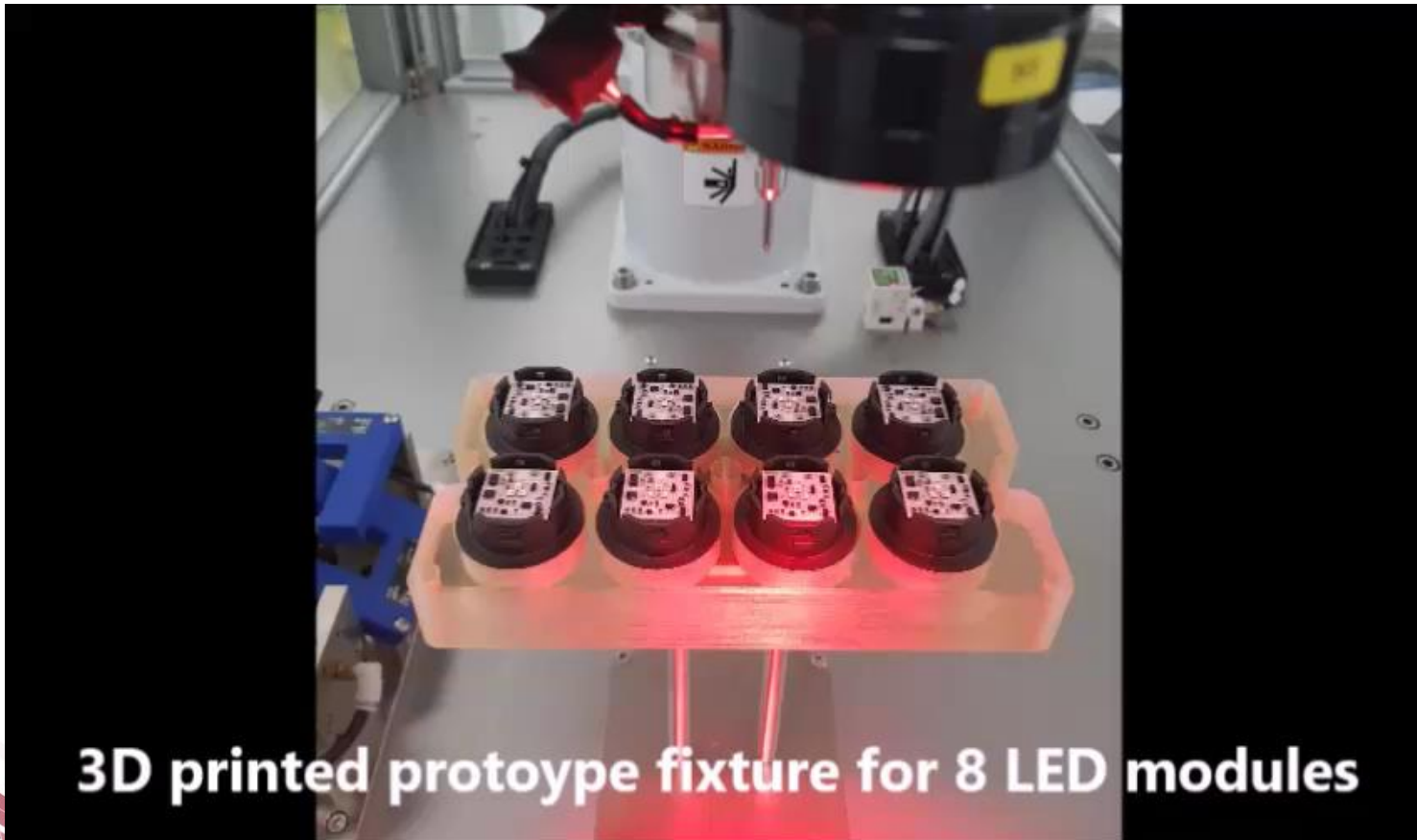
Cu core on lead frame



Wire bonds on connector

Automated Laser Assembly for SMT → Headlight *Universal Soldering Platform*

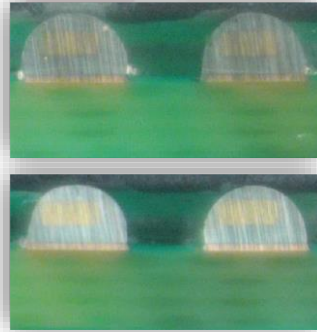
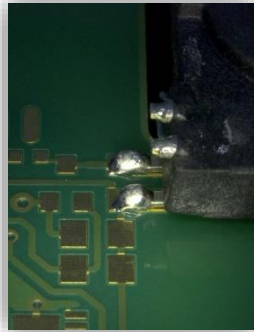
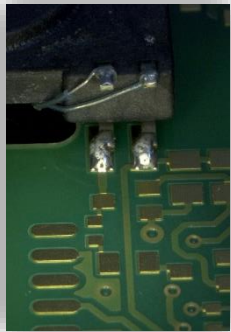
- contacting of power diode pins on LTCC
- Automotive application for head light
- 1800 μ m application SAC_305
- VIA = 1.8mm x 1.2 μ m
- Pin diameter: 0.6mm



Automated Laser Assembly for SMT

Universal Soldering Platform

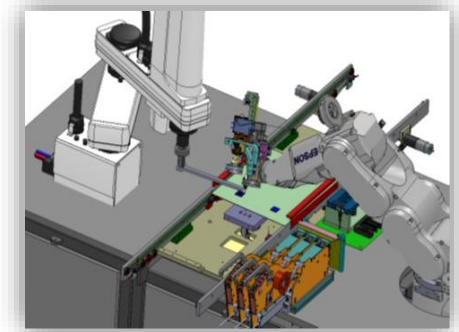
- Complete solution for SMD & THT soldering of large devices transformer, coils, connectors, HF-cable, etc.
- From cassette loading, to device attach, soldering (SB² or Wire), e-test, sorting and unloading into cassette



Sample of product: Transformer assembly on PCB



Final product



Double robot system and reel-to-reel lead

Description	Specification
Dimension (L x W X H)	Approx. 1500 x 3000 x 1900 mm
Work Area	Customizable work station
Cycle Time (incl. PnP and laser reflow)	10-12 sec / component
Accuracy	± 25µm
Tooling	Customization based on product
Die Handling	tape and reel
Substrate Handling	Automatic
Product Output	cassette
Pattern Recognition	Yes



Thank you for your attention

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