(Micro) Ball Placement for Wafer Level CSP

Thomas Oppert

www.pactech.de
Certified ISO 9001:2000 & TS 16949

Content

• Short company profile
• Soldering Processes
  – Single Ball Placement
  – Solder Ball Jetting
    • Applications
      – Power Module
      – HDD
    – (Micro) Gang Ball Placement
      • Process flow
      • Applications
        – Wafer Level CSP

• Outlook
Pac Tech Corporate Profile

- 1995 Pac Tech GmbH established, Berlin-Germany
- 1997 1st Bumping facility in Nauen, Germany
- 2000 2nd Bumping facility in Fukui, Japan (Alpha Bumping Technologies - ABT, JV with Nagase)
- 2002, 3rd Bumping facility PacTech USA Inc., CA, USA
- 2005, Customer Service Center Thailand
- 2006, Pac Tech Asia (Penang, Malaysia - planned Q4)

- PT Germany: 125 employees
- PT USA, Inc.: 20 employees
- Sales Turnover 2006: 14 Million Euro (PT Germany)
- Shareholder Structure: NAGASE & CO., Ltd. Founders
NAGASE PROFILE

• HISTORY : Founded 1832, Incorporated 1917
• SALES : 5 billion US$
• STOCK : Listed TSE-1, OSE-1
• TYPE : Trading & Manufacturing
• FIELDS : Industrial & Consumer
• ITEMS : • Electronics, • Chemicals, • Plastics, • Pharmaceuticals, • Beauty Care,

Tokyo Head Office

Osaka Head Office

THE WORLD OF NAGASE
The Technology and Intelligence Oriented Company

NAGASE & CO., LTD.

www.nagase.co.jp
Soldering Processes & Soldering Equipment
Solder Bumping Technologies

Evaporated Solder Bump

Sputtered UBM + Plating

Sputtered UBM + Print (FCT)

Electroless UBM (+)
   a) solder paste printing
   b) Solder jetting
   c) Solder ball drop

C4 Solder

Solder

Au

Ni/Au

Pac Tech Packaging Technologies
Certified ISO 9001:2000 & TS 16949
# Pac Tech Equipment

**Bumping, Spin Coating, Gang Ball Placement, FC Assembly**

- Wafer Bumping
- Wafer Level Packaging
- CSP, BGA, HDD

<table>
<thead>
<tr>
<th>NiAu-UBM Wafer Bumping</th>
<th>Solder Ball Placement/Reflow</th>
<th>Spin Coater</th>
<th>Flip Chip Assembly</th>
<th>Gang Ball Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>PacLine 200/300</td>
<td>SB²-Jet</td>
<td>SC 200/300</td>
<td>LAPLACE</td>
<td>GBP 200/300</td>
</tr>
</tbody>
</table>

![Image of equipment](Image)
SB² - Solder Jet Speed & Ball Diameter

- Solder Jet Speed & Ball Diameter
- 1 ball/sec
- 5 balls/sec
- 10 balls/sec
- 3 balls/sec
- 1 ball/sec
- 200µm
- 120µm
- 100µm
- 80µm
- 60µm
- Gang Ball placement

Certified ISO 9001:2000 & TS 16949
Single Ball Placement
&
Solder Jetting
SB²-SM Process (standard)

Placement & Reflow of Solder Balls

Certified ISO 9001:2000 & TS 16949
Laser Soldering SB²-Jet

Schematic Of The SB²-Jet Process
SB²-Jet Advantages

- No tooling
- Solder ball diameters from 80µm to 760µm
- Solder alloys: SnPb, SnAg, SnAgCu, AuSn
- No flux
- No mechanical stress/contact
- No thermal stress
- No additional reflow
- No cleaning of flux residues
- Fine pitch applications (120µm)
SB²-Applications

- Wafer Bumping
- BGA/ CSP Bumping
- Wafer Level CSP Bumping
- Rework/ Repair
- Optoelectronic Packaging
- SAW, BAW
- MEMS & 3-D Packaging
- Hard Disk Drive (HGA, HSA)
- Camera Modules
SB² - Equipment

Semiautomatic SB²-SM

SB²-Jet LF with R2R

SB²-Jet LF

Automatic SB²-Jet

ESD version of SB²-Jet
For HGA & HSA Assembly

300 mm
Laser Soldering of Power Module

*Ceramic substrate:*

Fig 1. small pin overview

Fig 2. small pin detail view

Fig 3 small pin top view

Fig 4. big pin top view
Laser Soldering of Power Module

Aluminum substrate:

Fig. 5 small pin overview

Fig. 6 small pin detail view

Fig. 7 big pin top view 1

Fig. 8 big pin top view 2
Laser Soldering of Power Module

FR4 substrate:

Fig. 9 small pin overview

Fig. 10 small pin detail view

Fig. 11 small pin top view

Fig. 12 big pin
Process parameter:
- 1,2mm solder ball used
- flux has been used for all connections (Cu-pad)
- substrate has been heated up to 135°C
- laser pulse provided by 200W diode laser
- laser pulse length 100ms-150ms (depending on substrate material)
- bonding angle 30°
SB²-Applications

Read Write Head for Hard Disk Drive

Electrical connection of a) suspension and b) slider
Bottom view of a MAGMA device assembled and mounted on a suspension

- Silicon stator (non-moving, attached to suspension)
- Silicon rotor (moving, holds magnet and slider)
- Magnet/ bottom keeper
- Narrow beam flexure (connects rotor to stator)
- Read / write transducer
- Electrical connections to read / write slider
- Electrical connections to drive coil
- Suspension
Cross Section of a Flex Suspension
Laser Soldering of Slider/Suspension

Process parameter:
- 80µm solder ball used
- No flux has been used
- No pre-heating of the substrate
- Laser pulse provided by 40W fibre laser
- Laser pulse length 10ms
- Bonding angle 45°
(Micro) Gang Ball Placement
Principles of available Process Technologies

A) “Ball Drop” Process

B) Ball Transfer Process

Certified ISO 9001:2000 & TS 16949
Solder Ball Transfer by GBP - Ball Pickup

1. Solder Ball
2. Bond Tool
3. Mask
4. Vacuum
5. Vibration
Solder Ball Transfer by GBP – Ball Placement

1. Solder Ball
2. Bond Tool
3. Mask
4. Flux
5. Wafer
6. UBM

Certified ISO 9001:2000 & TS 16949
Automatic Gang Ball Placer for Micro Ball Placement 1/2

- Cassette to Cassette robot handling f. wafer up to 12"
- Integrated rework capability
  - 100% yield
- 2x optical inspection
  - 1st after ball transfer
  - 2nd after repair
- min ball size 80µm
- pre-fluxing by printing/spraying
- UPH 5min/Wafer (8"

1st fully auto machine already installed in Japan

300 mm Capability !
Automatic Gang Ball Placer for Micro Ball Placement 2/2

- 8” Wafer
- Pitch 200μm
- 400,000 I/O’s
- 100μm solder balls SnAgCu
Semiautomatic Gang Solder Ball Placer GBP 200

- 4” - 8” Wafer
Wafer Level CSP Application

- eutectic SnPb or lead-free
- pitches: 120µm or higher
- wafer sizes: 4” – 8”
- solder ball diameter: 80 - 500 µm
Wafer on bond stage
Arrangement plate after sucking of spheres
Detail view of the Arrangement Plate after Spheres sucking
Detail view of the Placing on the Wafer
Outlook

- **Solder Jetting**
  - 60µm balls (in qualification)
    - Release for production Q2 2007
- **Micro Gang Ball Placement**
  - 100µm in production
  - 80µm in qualification
  - 60µm, 40µm, 30µm to be developed until 2009 (Project Pro UFP)
Contacts:

**Pac Tech GmbH**

<table>
<thead>
<tr>
<th>Contact</th>
<th>Telephone</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Elke Zakel</td>
<td>+49-3321-4495-100</td>
<td>+49-3321-4495-110</td>
<td><a href="mailto:zakel@pactech.de">zakel@pactech.de</a></td>
</tr>
<tr>
<td>Thomas Oppert</td>
<td>+49-3321-4495-100</td>
<td>+49-3321-4495-110</td>
<td><a href="mailto:oppert@pactech.de">oppert@pactech.de</a></td>
</tr>
</tbody>
</table>

**Pac Tech USA Inc.**

<table>
<thead>
<tr>
<th>Contact</th>
<th>Telephone</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Thorsten Teutsch</td>
<td>+1-408-588-1925</td>
<td>+1-408-588-1927</td>
<td><a href="mailto:teutsch@pactech-usa.com">teutsch@pactech-usa.com</a></td>
</tr>
</tbody>
</table>

www.pactech.de

www.pactech-usa.com