Unique encapsulation materials for Fan Out Wafer / Panel level package.

Sanyu Rec co.,ltd.

Semiconductor Dept.
Contents

1. Company profile
2. Package trend
3. Process for Wafer / Panel level package
4. Material portfolio
5. Sanyu Rec’s materials
Established in 1963. We are professional of compound formulator, Epoxy, Urethane, and Silicone. Located in Takatsuki-city Japan. It is between Kyoto and Osaka.
Sanyu Rec company profile

World-wide network of SR

- Shanghai Sanyu Rec (CHN-Shanghai)
  - ISO-9001.14001 certified

- Sanyu Jushi (MAL-Selenban)
  - ISO-9001.14001 certified

- Sanyu Rec Malaysia

- Epmar-chem. (USA—L.A.)

- Sanyu Rec india (IND-Bangalore)

- ESP chemical (KOR—Seoul)

- Taiwan-Sanyu (TWN—Taichung)

- Sanyu Rec (JPN - HQ/Osaka,Tokyo)
  - ISO-9001.14001 certified

- Head quarter
- Overseas plant
- Production partner

Chemical cocktail for solution
Contents

1. Company profile

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Wafer and Panel size will be larger and larger

- 100mm (1975~)
- 150mm (1980~)
- 200mm (1991~)
- 300mm (2001~)
- 450mm (20XX~)
- 500mm (2014~)
- 650mm (20XX~)

Increase of dies per wafer/panel

Chemical cocktail for solution

SANYU REC CO., LTD.
Market trend of Flip-chip Packages

- **QFN**
- **BGA(WB)**
- **fcCSP(C4)**
- **fcBGA**
- **fcCSP/BGA(CuP)**
- **FOWLP**
- **FIWLP**

**Chemical cocktail for solution**

SANYU REC CO., LTD.
Portfolio of Materials Required

- **CUF (Capillary Underfill)**
- **NCP (Non Conductive Paste)**
- **NCF (Non Conductive Film)**
- **Die Attach Paste**
- **MUF (tablet)**
- **LMUF (Liquid MUF)**
- **Liquid Encap. (WLP)**
- **Mold Sheet**
- **Granulated Powder**

Chemical cocktail for solution
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1. Company profile
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Encapsulation process for Wafer / Panel level package

- Transfer molding
- Vacuum printing
- Compression molding
- Curtain coat
- Vacuum lamination

Chemical cocktail for solution
Process for Wafer/Panel level package

Transfer molding

Resin flow

Suitable material type:
- Tablet (EMC)
- Liquid
- Granule/Powder (shaped)

Heat and Pressure

Chemical cocktail for solution
Process for Wafer/Panel level package

Vacuum printing

VPES: Vacuum Printing Encapsulation System

Equipment by New-long

Suitable material type: Liquid

Printing by PES & VPES

VPES HA IV:
- Printing area 200 × 250 mm

VPES HA V:
- Printing area 300 × 400 mm +

Under vacuum

Squeegee
Liquid resin
Stencil

Vacuum chamber

Back to the atmospheric pressure

Chemical cocktail for solution

SANYU REC CO., LTD.
Process for Wafer/Panel level package

Compression molding

FFT type by TOWA

Cavity down type by TOWA

Suitable material type:
- Granule
- Powder
- Liquid
- Sheet

Chemical cocktail for solution

SANYU REC CO., LTD.
Process for Wafer/Panel level package

Curtain coat

Material is injected from slit die. Coating on wafer/panel

Suitable material type: Liquid
Vacuum lamination

1st stage with diaphragm press
2nd stage with metal press (If needed)

Suitable material type: Sheet
## Process for Wafer/Panel level package

<table>
<thead>
<tr>
<th></th>
<th><strong>Pros</strong></th>
<th><strong>Cons</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transfer mold</strong></td>
<td>High UPH</td>
<td>High pressure (wire sweep, broke)</td>
</tr>
<tr>
<td></td>
<td>Low running cost</td>
<td>Difficult to thin mold</td>
</tr>
<tr>
<td></td>
<td>Very popular</td>
<td>Yield loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expensive mold</td>
</tr>
<tr>
<td><strong>Vacuum printing</strong></td>
<td>Low initial cost</td>
<td>Unstable surface</td>
</tr>
<tr>
<td></td>
<td>Low stress</td>
<td>‘Dog ear’ phenomenon</td>
</tr>
<tr>
<td><strong>Compression mold</strong></td>
<td>Mold stability</td>
<td>Expensive initial cost</td>
</tr>
<tr>
<td></td>
<td>Many kind of material response</td>
<td>Release film required</td>
</tr>
<tr>
<td><strong>Curtain coat</strong></td>
<td>Excellent UPH</td>
<td>Unstable surface</td>
</tr>
<tr>
<td></td>
<td>Suitable for large area encap.</td>
<td>Unevenness of molding area</td>
</tr>
<tr>
<td><strong>Vacuum lamination</strong></td>
<td>Suitable for large area encap.</td>
<td>Carrier film required</td>
</tr>
<tr>
<td></td>
<td>Low initial cost</td>
<td>Unstable surface (1st only)</td>
</tr>
</tbody>
</table>
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3. Process for Wafer / Panel level package
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5. Sanyu Rec’s materials

Chemical cocktail for solution

SANYU REC CO., LTD.
## Portfolio of Materials Required

<table>
<thead>
<tr>
<th>Application</th>
<th>Process</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC MUF</td>
<td>Lamination</td>
<td>Mold Sheet</td>
</tr>
<tr>
<td>FIWLP</td>
<td>Compression mold</td>
<td>Granule / Powder</td>
</tr>
<tr>
<td>Panel level package</td>
<td>Printing</td>
<td>Liquid encapsulation</td>
</tr>
<tr>
<td>SiP / Module</td>
<td>Curtain coat</td>
<td>Pellet / Tablet</td>
</tr>
</tbody>
</table>

**Chemical cocktail for solution**

SANYU REC CO., LTD.
## Portfolio of Materials Required

<table>
<thead>
<tr>
<th>Application</th>
<th>Material (current)</th>
<th>Material (future)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUF (CSP)</td>
<td>Pellet / Tablet</td>
<td>Pellet / Tablet</td>
</tr>
<tr>
<td></td>
<td>Liquid</td>
<td>Liquid</td>
</tr>
<tr>
<td>FIWLP</td>
<td>Liquid</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Granule / Powder</td>
<td>Granule / Powder</td>
</tr>
<tr>
<td>FOWLP</td>
<td>Liquid</td>
<td>Liquid</td>
</tr>
<tr>
<td></td>
<td>Granule / Powder</td>
<td>Granule / Powder</td>
</tr>
<tr>
<td>Panel level package</td>
<td>Mold sheet (Film)</td>
<td>Granule / Powder</td>
</tr>
<tr>
<td></td>
<td>Mold sheet (Film)</td>
<td>Mold sheet (Film)</td>
</tr>
<tr>
<td>SiP / Module</td>
<td>Liquid</td>
<td>Granule / Powder</td>
</tr>
<tr>
<td></td>
<td>Pellet / Tablet</td>
<td>Liquid</td>
</tr>
</tbody>
</table>
## Characteristics of each material

<table>
<thead>
<tr>
<th></th>
<th>Adhesion</th>
<th>Shrinkage</th>
<th>Flow mark</th>
<th>Pressure in process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tablet</strong></td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Liquid</strong></td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td><strong>Granule/Powder</strong></td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td><strong>Sheet</strong></td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Narrow gap Filling</th>
<th>Weight adjustment</th>
<th>Large area encapsulation</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tablet</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td><strong>Liquid</strong></td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>Granule/Powder</strong></td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td><strong>Sheet</strong></td>
<td>++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
</tbody>
</table>

**Chemical cocktail for solution**

SANYU REC CO., LTD.
Viscosities of each material

Chemical cocktail for solution
### Characteristics of each material

<table>
<thead>
<tr>
<th>Material</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tablet</td>
<td>Low cost&lt;br&gt;Quick cure&lt;br&gt;Easy handling</td>
<td>Much yield loss (cull and runner)&lt;br&gt;High pressure&lt;br&gt;Die shift&lt;br&gt;Unsuitable for large area encap.</td>
</tr>
<tr>
<td>Liquid</td>
<td>Weight adjustment&lt;br&gt;Filling property&lt;br&gt;Low temp cure&lt;br&gt;Low stress</td>
<td>Cost&lt;br&gt;Unsuitable for large area encap.&lt;br&gt;Flow mark&lt;br&gt;Unsuitable for thin mold</td>
</tr>
<tr>
<td>Granule/Powder</td>
<td>Weight adjustment&lt;br&gt;Low cost&lt;br&gt;Suitable for large area encap.</td>
<td>Dust&lt;br&gt;Unsuitable for thin mold&lt;br&gt;Blocking</td>
</tr>
<tr>
<td>Sheet</td>
<td>No flow mark&lt;br&gt;Suitable for thin mold&lt;br&gt;Suitable for large area encap.&lt;br&gt;Multi layer possible</td>
<td>Weight adjustment&lt;br&gt;Cost&lt;br&gt;No Automation yet</td>
</tr>
</tbody>
</table>
1. Company profile

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Sanyu Rec Product line up

- CUF
- LMUF (Liquid MUF)
- Liquid Encap. (WLP)
- Mold Sheet
- Powder
- NCP/NCF
- Die Attach

Panel size

Pin Count

Time Stream

Chemical cocktail for solution

SANYU REC CO., LTD.
Product Line of Semiconductor Department

- Liquid encapsulation materials
  (Wafer/Panel Level Package) (module/SiP)

- Under-fill materials
  (Capillary UF/Secondary UF/Pre-applied UF)

- High thermal conductive materials

- Die attach materials

- Mold sheet materials

- Powder materials
Liquid Encapsulation materials
(Wafer/Panel Level Package) (module/SiP)

Under Fill materials
(Capillary UF/Secondary UF/Pre-applied UF)

High Thermal Conductive Encapsulation

Die Attach Materials

Mold Sheet

Powder compound
# Sanyu Rec’s Liquid materials

for Compression molding

<table>
<thead>
<tr>
<th>Item</th>
<th>EA-443</th>
<th>EF-364S3</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Low CTE &amp; High Tg</td>
<td>Low modulus &amp; Low Tg (Low warpage)</td>
<td>–</td>
</tr>
<tr>
<td>Filler content</td>
<td>88wt%</td>
<td>75 wt%</td>
<td>–</td>
</tr>
<tr>
<td>Filler size (Max/Ave)</td>
<td>55μm/20μm</td>
<td>25μm/5μm</td>
<td>–</td>
</tr>
<tr>
<td>Viscosity</td>
<td>200 Pa·s</td>
<td>110 Pa·s</td>
<td>B type 23°C,20rpm</td>
</tr>
<tr>
<td>Thixotropic Index</td>
<td>1.5</td>
<td>1.0</td>
<td>2rpm/20rpm</td>
</tr>
<tr>
<td>Cure condition</td>
<td>Pre cure(In mold) 140°C / 10min</td>
<td>Pre cure(In mold) 130°C / &lt;30min</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Post cure 180°C / 60min</td>
<td>Post cure 150°C / 60min</td>
<td></td>
</tr>
<tr>
<td>Tg</td>
<td>205°C</td>
<td>30°C</td>
<td>TMA</td>
</tr>
<tr>
<td>CTE α1/α2</td>
<td>7／34 ppm</td>
<td>20／85 ppm</td>
<td>TMA</td>
</tr>
<tr>
<td>Young modulus</td>
<td>22 GPa</td>
<td>11 GPa</td>
<td>DMA 25°C</td>
</tr>
</tbody>
</table>

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*Note: The image contains additional text and logo, which is not transcribed.*
## Sanyu Rec’s Liquid materials

for Printing and Curtain coat

<table>
<thead>
<tr>
<th>Item</th>
<th>EF-300M</th>
<th>EF-380</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features</strong></td>
<td>for Curtain coat&lt;br&gt;Low CTE&lt;br&gt;High Reliability</td>
<td>for Printing&lt;br&gt;Low CTE&lt;br&gt;High Reliability</td>
<td>–</td>
</tr>
<tr>
<td>Filler content</td>
<td>78 wt%</td>
<td>81 wt%</td>
<td>–</td>
</tr>
<tr>
<td>Filler size (Max/Ave)</td>
<td>25μm/6μm</td>
<td>25μm/8μm</td>
<td>–</td>
</tr>
<tr>
<td>Viscosity</td>
<td>210 Pa·s</td>
<td>310 Pa·s</td>
<td>B type 23°C, 20rpm</td>
</tr>
<tr>
<td>Thixotropic Index</td>
<td>&lt; 1.0</td>
<td>2.0</td>
<td>2rpm/20rpm</td>
</tr>
<tr>
<td><strong>Cure condition</strong></td>
<td>Pre cure (In oven)&lt;br&gt;100°C/90min</td>
<td>Post cure&lt;br&gt;150°C / 60min</td>
<td>–</td>
</tr>
<tr>
<td>Tg</td>
<td>60°C</td>
<td>60°C</td>
<td>TMA</td>
</tr>
<tr>
<td>CTE α1/α2</td>
<td>18/60 ppm</td>
<td>13/55 ppm</td>
<td>TMA</td>
</tr>
<tr>
<td>Young modulus</td>
<td>18 GPa</td>
<td>21 GPa</td>
<td>DMA 25°C</td>
</tr>
</tbody>
</table>

*Chemical cocktail for solution*

SANYU REC CO., LTD.
Wafer molded with EF-364S3.

Side view

Top view

After Post Mold Cure
775umt wafer  200umt mold
with 300mm diameter wafer

Warpage  Less than 1mm
No flow mark
<table>
<thead>
<tr>
<th>Item</th>
<th>RP-1069</th>
<th>RP-1075</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Low warpage</td>
<td>Low warpage</td>
<td>Fine filler</td>
</tr>
<tr>
<td>Filler content</td>
<td>89 wt%</td>
<td>86 wt%</td>
<td>–</td>
</tr>
<tr>
<td>Filler size (Max/Ave)</td>
<td>20μm / 8μm</td>
<td>10μm / 3μm</td>
<td>–</td>
</tr>
<tr>
<td>Mold condition</td>
<td>Pre cure (In mold) 150°C / 4min</td>
<td>Pre cure (In mold) 150°C / 2min</td>
<td>Post cure 150°C / 60min</td>
</tr>
<tr>
<td>Tg</td>
<td>145°C</td>
<td>150°C</td>
<td>DMA</td>
</tr>
<tr>
<td>CTE α1/α2</td>
<td>6/39 ppm</td>
<td>13/60 ppm</td>
<td>TMA</td>
</tr>
<tr>
<td>Young modulus</td>
<td>16 GPa</td>
<td>14 GPa</td>
<td>DMA 25°C</td>
</tr>
<tr>
<td>Warpage</td>
<td>&lt; 1mm</td>
<td>&lt; 1.2mm</td>
<td>775μmt 12’ wafer, 200μmt mold</td>
</tr>
</tbody>
</table>

Sanyu Rec’s **Powder** materials for Compression molding

Chemical cocktail for solution

SANYU REC CO., LTD.
Wafer molded with **Powder** materials for Compression molding

Pic of **RP-1069**.
Very small warpage
After Post Mold Cure

Pic of **RP-1075**.
Very small warpage
After Post Mold Cure

*Chemical cocktail for solution*
# Sanyu Rec’s Sheet materials

for Compression Molding and Vacuum Lamination

<table>
<thead>
<tr>
<th>Item</th>
<th>SLW-226</th>
<th>SLW-332</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Standard</td>
<td>Low modulus &amp; high Tg</td>
<td>–</td>
</tr>
<tr>
<td>Filler content</td>
<td>71wt%</td>
<td>74 wt%</td>
<td>–</td>
</tr>
<tr>
<td>Filler size (Max/Ave)</td>
<td>55μm/20μm</td>
<td>25μm / 8μm</td>
<td>–</td>
</tr>
<tr>
<td>In Mold condition</td>
<td>150°C / 10min</td>
<td>150°C / 2min</td>
<td>Post cure 150°C / 60min</td>
</tr>
<tr>
<td>Laminate condition</td>
<td>100°C / 0.5min</td>
<td>100°C / 0.5min</td>
<td></td>
</tr>
<tr>
<td>Tg</td>
<td>85°C</td>
<td>190°C</td>
<td>DMA</td>
</tr>
<tr>
<td>CTE α1/α2</td>
<td>20／73 ppm</td>
<td>16／48 ppm</td>
<td>TMA</td>
</tr>
<tr>
<td>Young modulus</td>
<td>17 Gpa</td>
<td>12 Gpa</td>
<td>DMA 25°C</td>
</tr>
<tr>
<td>Warpage</td>
<td>&lt; 4mm</td>
<td>&lt; 4mm</td>
<td>550μmt 400x500 glass panel mold</td>
</tr>
</tbody>
</table>
Sanyu Rec’s **Sheet** materials

for Compression Molding and Vacuum Lamination

- CM with cavity down by TOWA
- CM with cavity up by ApicYamada
- Vacuum Lamination with Meiki

For **Compression molding** process, both sides film need to be peeled off before molding.

For **Vacuum Lamination** process, only one side of film needs to be peeled off before molding.

After PMC, peel off the other side film of mold sheet. And, side frame is required.
Please visit our booth!

Sanyu Rec booth is Here!

UniWave enterprise
Materials pavilion
1st floor Booth No.2235
Close to ‘K’ entrance

Chemical cocktail for solution
SANYU REC CO., LTD.
Thank you for your attention.