FOWLP Thermal Debonding: Easing Manufacturing Constraints

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What is Fanout?

- **Fan-out** is a type of advanced chip packaging where the redistribution layer (RDL) are routed outside the surface area of the die.

- Several noted advantages are:
  - Good electrical performance
  - Enables high density routing
  - Enables multi die package configuration
Die Shift is a defect in which the actual die location has an offset from the pre-defined position by a certain distance.

Warpage is the physical deformation encountered by the wafer due to coefficient of thermal expansion (CTE) mismatch between silicon and mold.
Fanout Process

Chip First – Face up or Face down

Die Preparation

Wafer Reconstruction

Layer Build Up (Redistribution)

Die/Package Finishing

Credits: Deca
The reconstruction (wafer) or panelization (panel) process is the key differentiator of Fanout in comparison to *WLCSP/Fan-in process.
Thermal Debonding is the process of separating the reconstructed wafer from its carrier. The whole process is composed of several thermal treatment with the aim of:

- Stress free carrier removal
- Smooth Detaping
- No tape residue
- Minimal warpage

Key parameters:
- Temperature
- Soak time
- Detape speed
- Detape angle
Thermal Debond

The wafer then goes into cooling stage.

This base process for thermal debonding is:

1. Pre-heat
2. Debond
3. Detape
4. Cooling
5. Unload
6. Placement
7. Carrier Sandwiching
8. Debonding
**Enhanced Thermal Debond**

**Improvement for thermal Debond**

1. Add a second heating treatment
Enhanced Thermal Debond

Benefits of a 2nd heating treatment

1. Allows “shock and lock” method which is a way to lock flatness into the wafer
2. Intermediate – slow cooling; instead of straight from debond temp (≈180°C to 200°C) to room temperature, an intermediate temp of ≈60°C to 110°C is done
Enhanced Thermal Debond

**Shock and Lock**

*For wafers with higher silicon content, high temperature for 2\(^{nd}\) treatment showed better warpage performance*
Enhanced Thermal Debond

Intermediate – Slow Cooling

For wafers with more mold compound (thick overmold), warpage is minimal with slow cooling.
Transporting/handling the wafer from hot to cold. This is critical for FO, Molded wafer is very pliable when hot.
We have observed a different heat dissipation behavior between slide system and pick and place.

Slide system being more uniform and resulting to better warpage behavior.

Data also shows increasing temperature result to higher warpage when doing pick and place.
Conclusion

• Enhancing Thermal Debond method shows great benefits in reducing warpage, this is done by
  • Adding a 2\textsuperscript{nd} stage of thermal treatment
  • Eliminating pick and place handling when wafer is in high temperature state
• This minimal warpage output of the end process of the reconstruction module can greatly address the issues of handling in the next FO step which in RDL
Thank You! Vielen Dank!

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