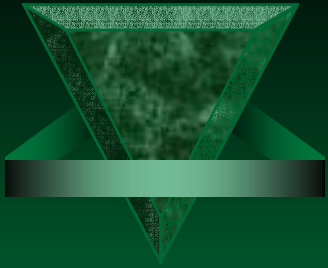




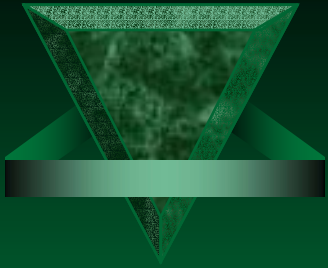
Assembly process of Lead-Free Bumped Flip-Chip in packaging

Jing Li Nov. 6th



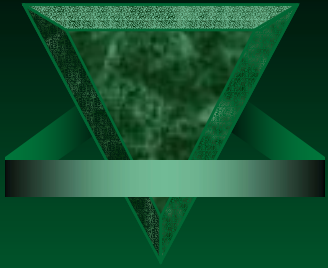
The trend in electronics of today

- ✓ Smaller products with more functions
- ✓ Better performance
- ✓ Lower price
- ✓ Greener, more environmentally friendly products.



Our goal

- ✓ Lead (Pb), a major component in solder bumps has long been recognized to be harmful to human beings.
- ✓ Our goal is to replace the Pb in solder bumps with some other lead-free alloy.

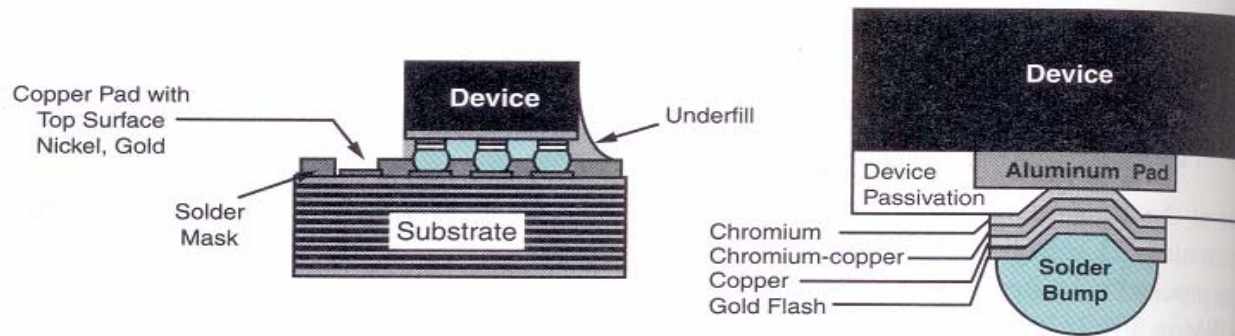


Possible lead-free candidates

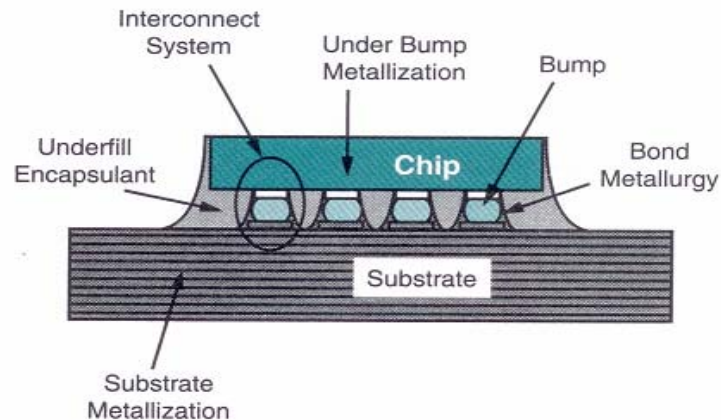
Alloy	Melting Point
Sn96.5/Ag3.5	221° C
Sn99.3/Cu0.7	227° C
Sn95.5/Ag3.5/Cu1.0	217° C
Sn95/Sb5	232-240° C
Sn91/Zn9	199° C
Sn/Ag/Bi	Ranging according to compositions usually above 200° C

Among these candidates, the ternary Sn/Ag/Cu demonstrates good strength, fatigue resistance and adequate wetting characteristics.

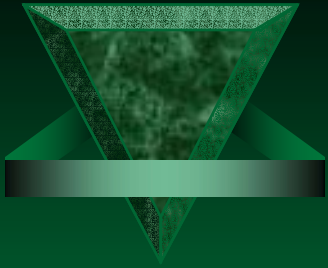
Flip-chip



(a) Solder Interconnection



Source: Microsystems Packaging (Rao. R. Tummala)



Flip-chip assembly with no-flow underfill

Use of underfill:

Board preparation



Underfill dispense



Die placement

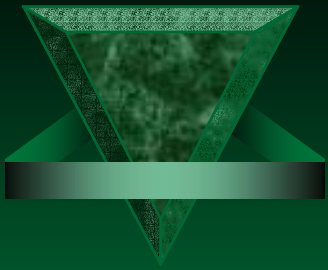


reflow

1. Compensate the CTE mismatch between chip and substrate.

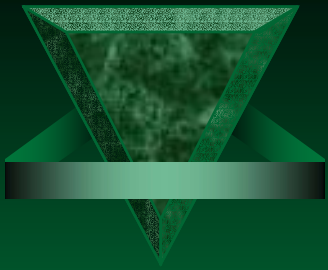
2. The integrated flux can eliminate the oxides on the surface of solder bumps

3. Protect interconnection from environmental effects (i.e. moisture)



Challenges in lead-free solder bumping

1. The melting point of the Sn/Ag/Cu is more than 30 ° C higher than that of the eutectic Sn/Pb, high warpage is introduced to the board.
- Need the underfill to have high enough curing latency so that the underfill wouldn't gel before the solder joints are connected.
 - The flux incorporated into the no-flow underfill might not have enough fluxing capability for lead-free solder.



Effort

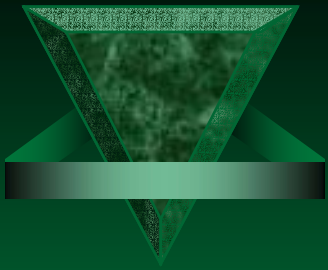
Assemble the new underfill and lead-free solder bumped chip and use the TMA, DMA, TGA to study the thermal and mechanical characteristics of the new material and use C-SAM to check the result of process.

The first successful no-flow underfill was developed and patented by C.P. Wong and S.H. Shi.

The lead-free solder bumped chip used in the process was 200um PB8 daisy chained chip:

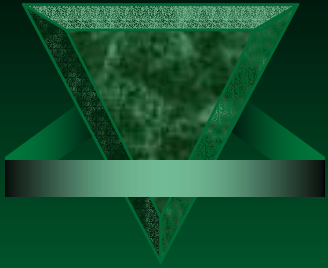
passivation layer: silicon nitride

UBM: Al/Ni/Cu



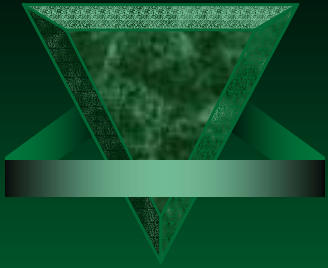
Conclusions

- ✔ The solder wetting test proved that the new underfills have sufficient fluxing capability for lead-free solder to wet on copper board during reflow.
- ✔ 100% solder joint yield was achieved using PB-8 chip
- ✔ New problem: high curing temperature leads to large amount of out-gassing during curing, which would cause voids in the package.



New effort

- ✓ Changed the formula and try to achieve 100um pitch.



Thanks

- ✓ Thank Packaging Research Center interconnection group and Dr. C.P. Wong's group for giving me the current information of their research.