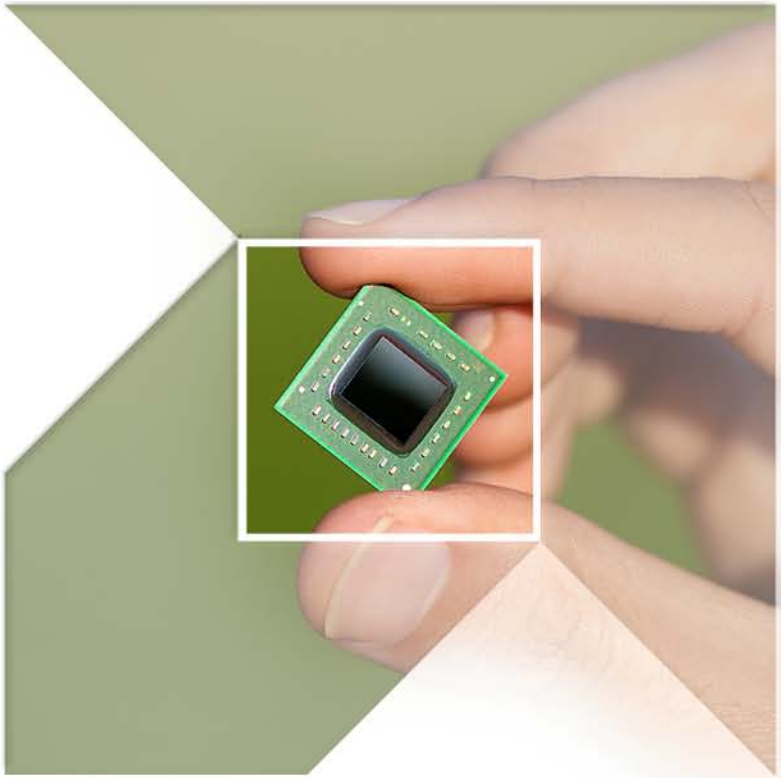

LADDERED UBM (LUBM)

Bump Reliability Improvement through Distribution of Load Concentration Points

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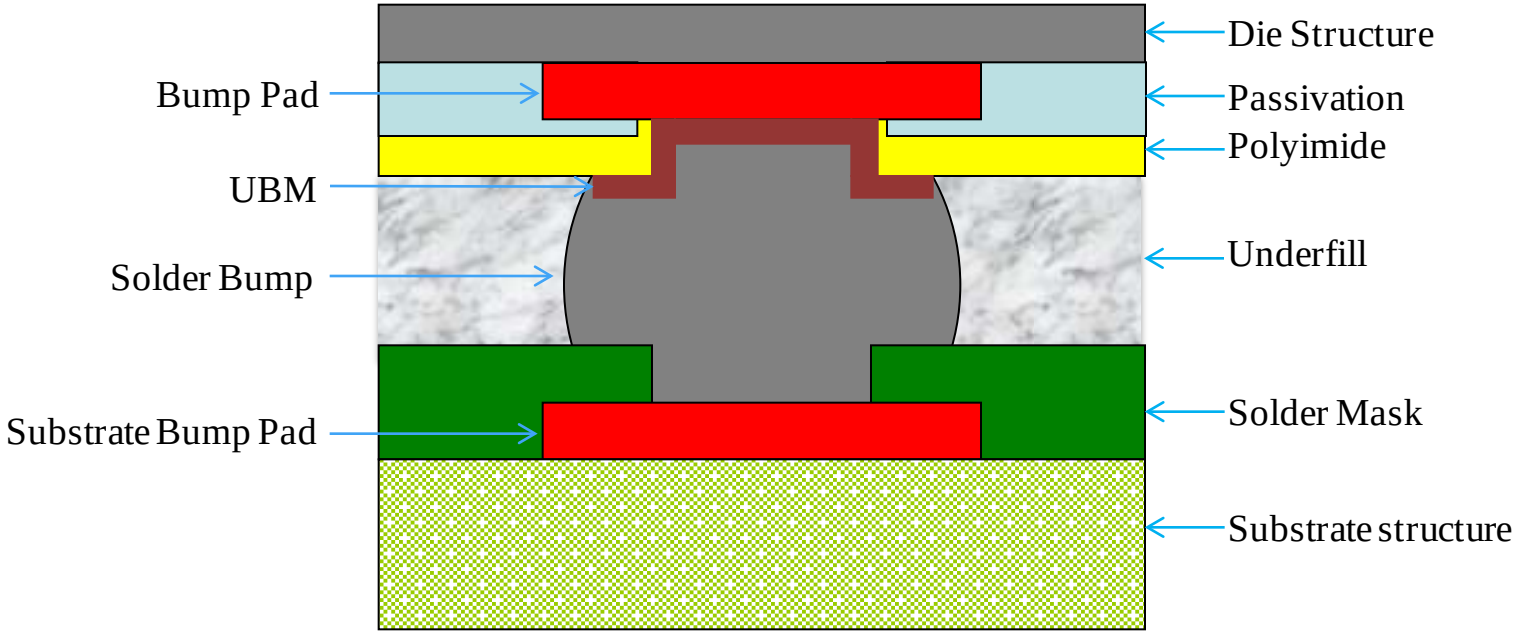
March 5 to 8, 2012
IMAPS 8th International Conference and Exhibition on Device Packaging

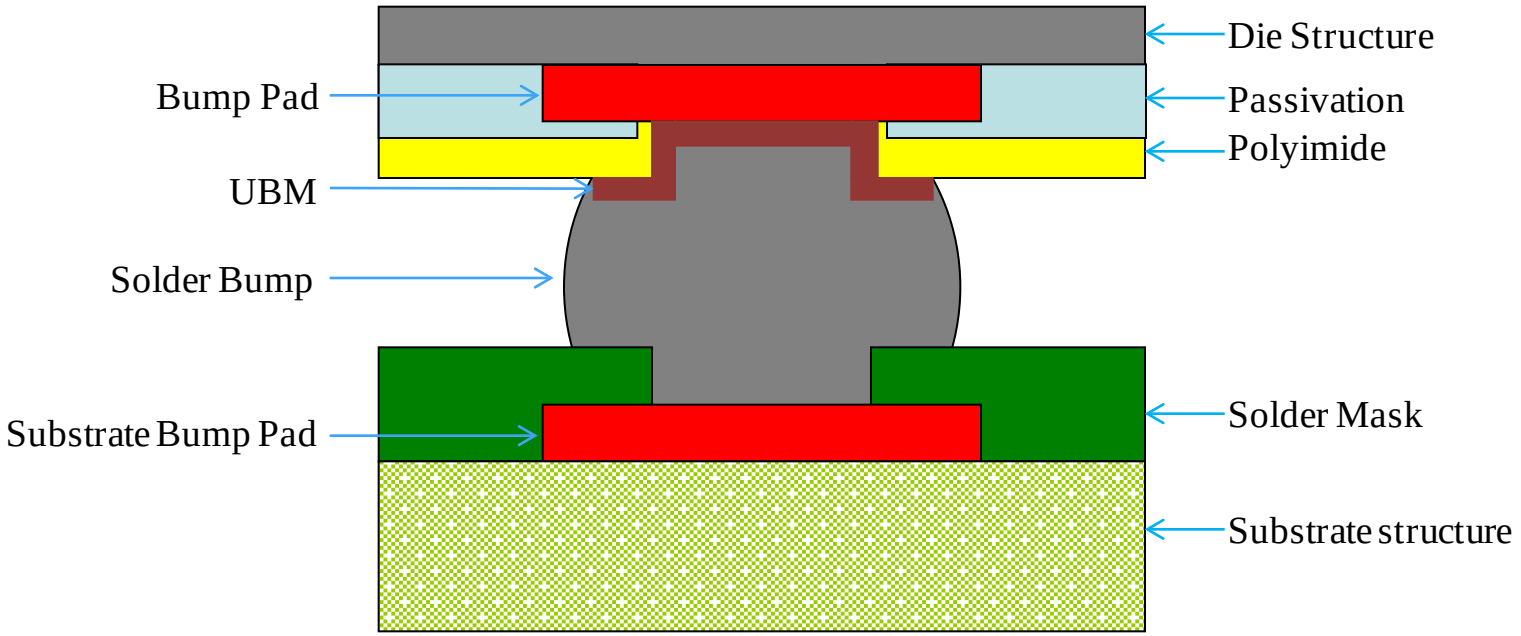
DISCUSSION TOPICS

- COMPARISON OF A CONVENTIONAL UBM STRUCTURE AND A LADDERED-UBM STRUCTURE
  - Construction
  - Stress Distribution
  - Computational Mechanics
  - Assembly and Reliability Test Result
- SUMMARY

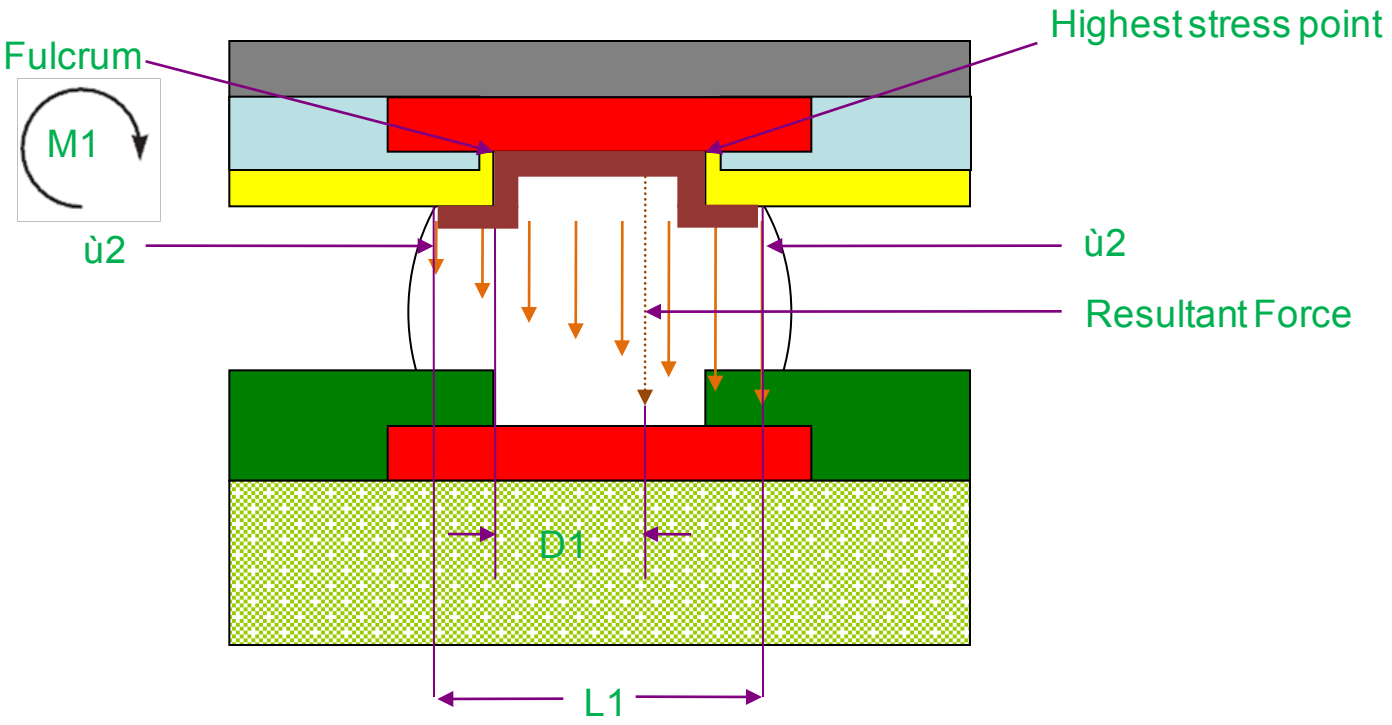
TYPICAL CROSS SECTION DIAGRAM OF A FLIPCHIP PACKAGE



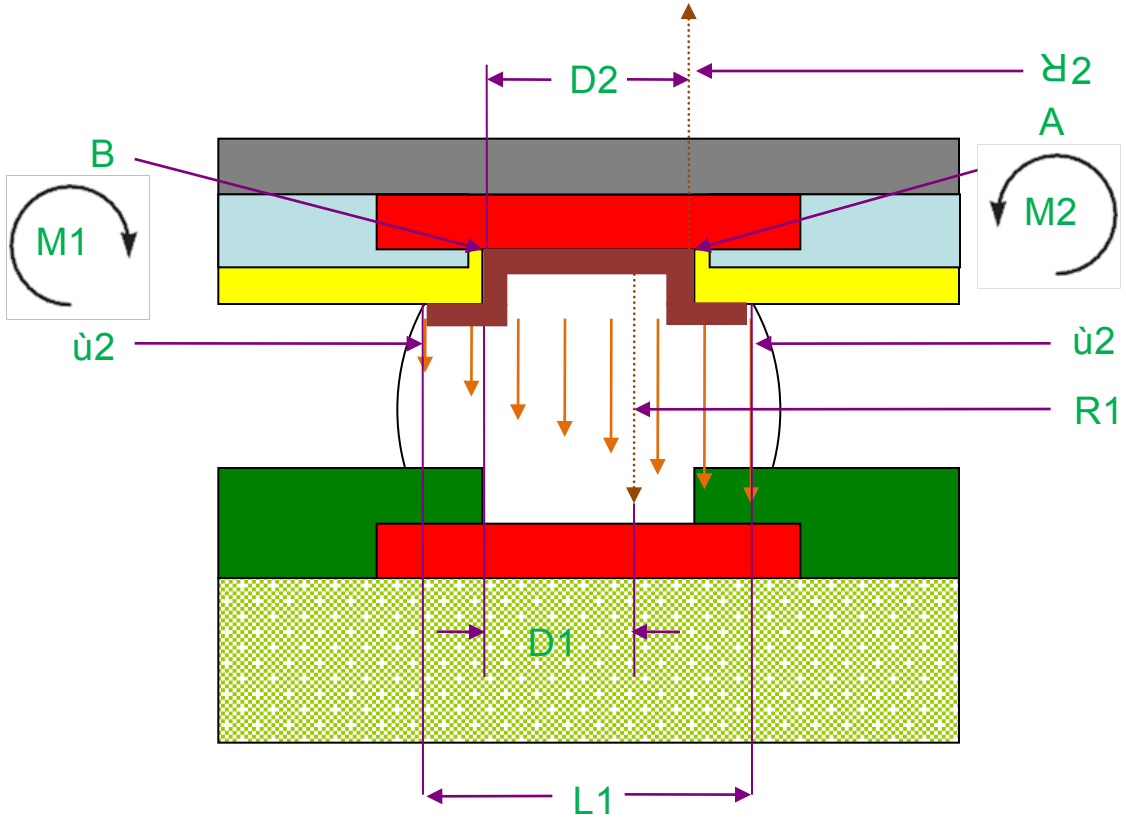
TYPICAL CROSS SECTION DIAGRAM OF A FLIPCHIP PACKAGE AFTER DIE ATTACH PROCESS WITH CONVENTIONAL UBM SOLDER BUMP STRUCTURE



STRESS DISTRIBUTION ON A CONVENTIONAL UBM SOLDER BUMP STRUCTURE.



COMPUTATIONAL MECHANICS ON A CONVENTIONAL UBM SOLDER BUMP STRUCTURE

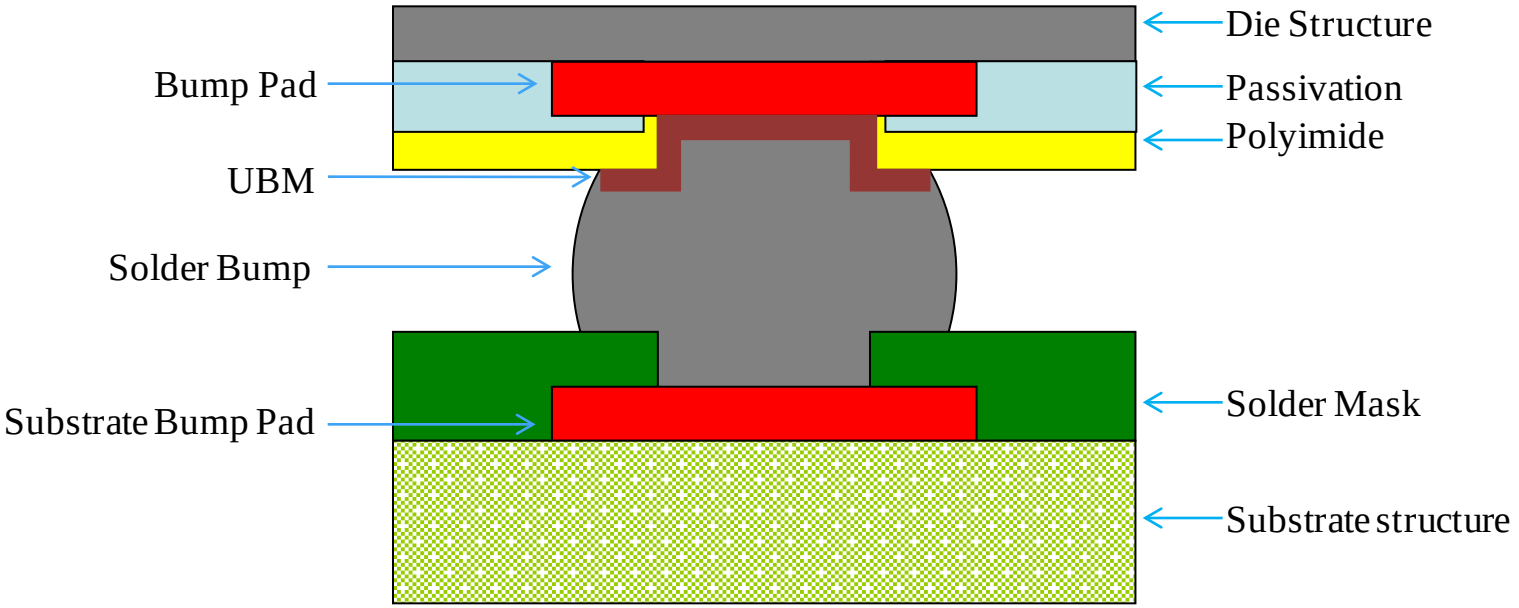


Equations :
(1) M1 = R1D1
(2) M2 = R2D2
(3) M1 = M2
(4) R2 = R1D1/D2

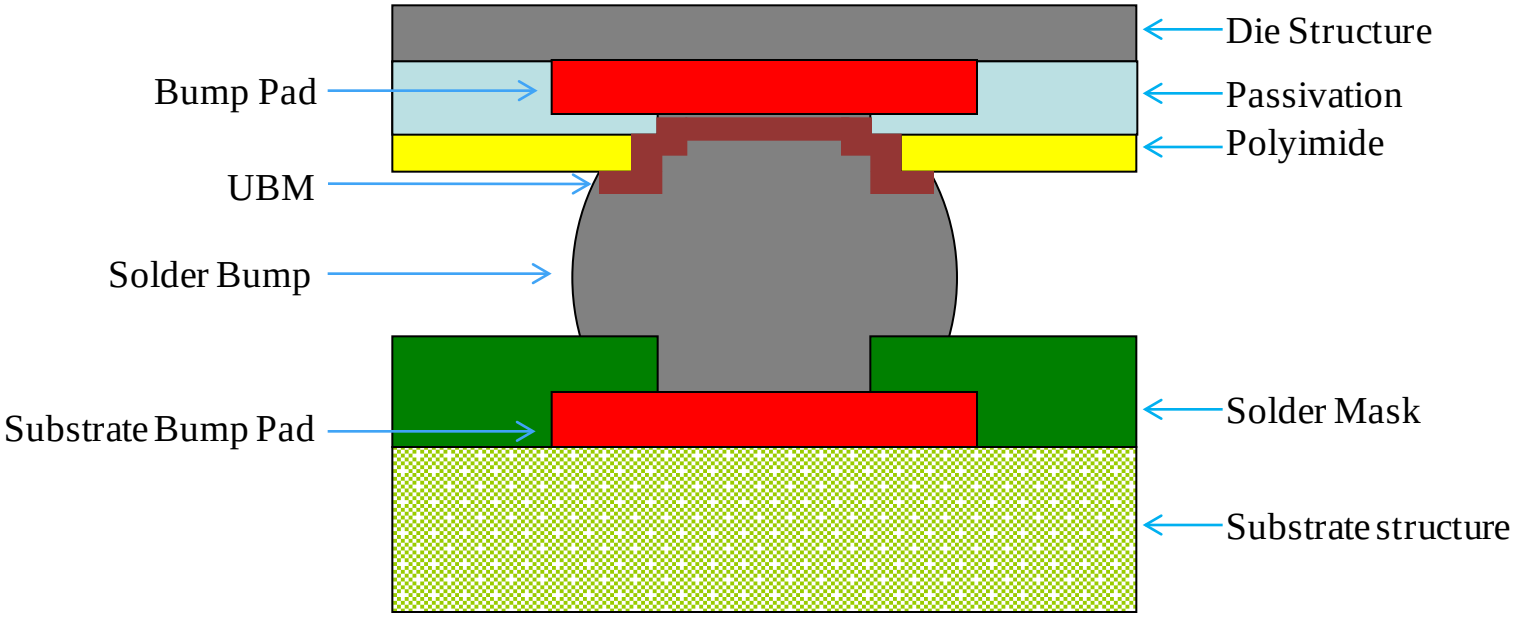
Given:
R1 = 10gF
D1 = 60um
D2 = 45um

Computed solution:
R2 = 13.33gF

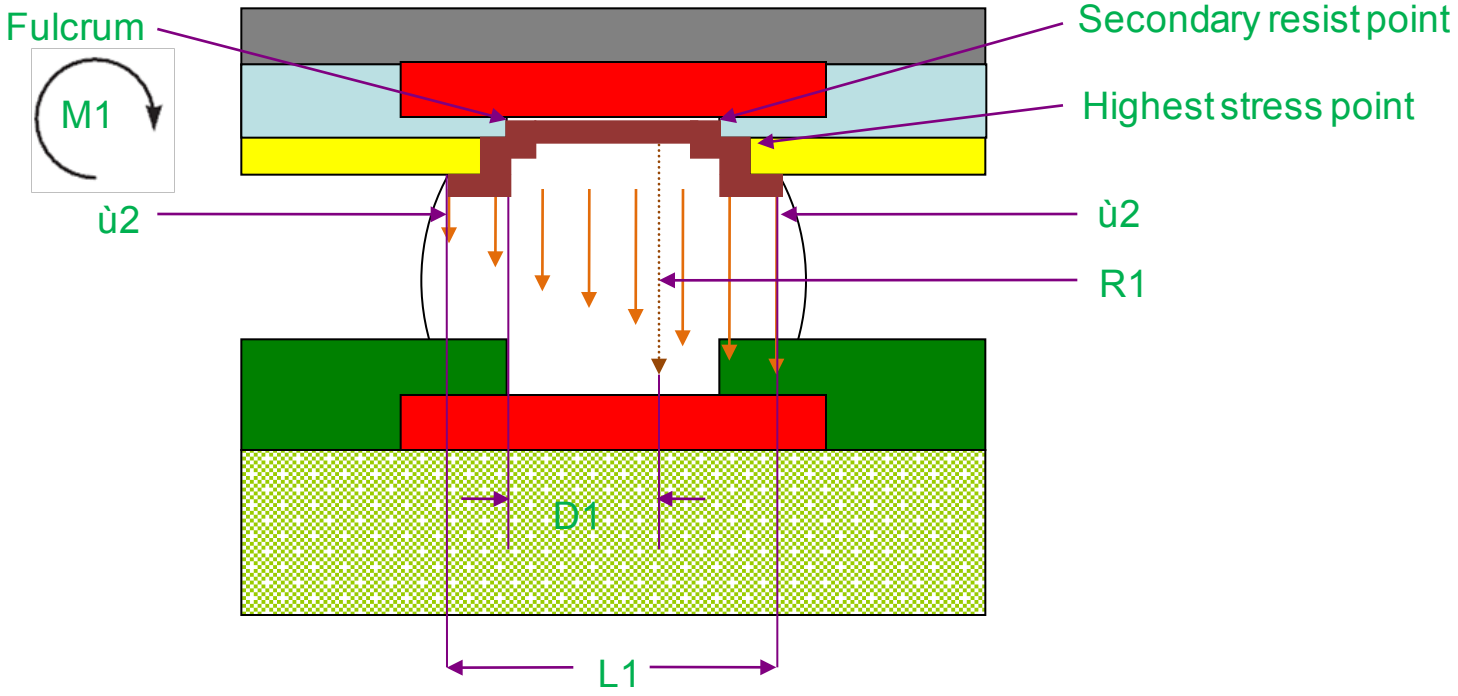
CROSS SECTION DIAGRAM OF A CONVENTIONAL UBM SOLDER BUMP STRUCTURE



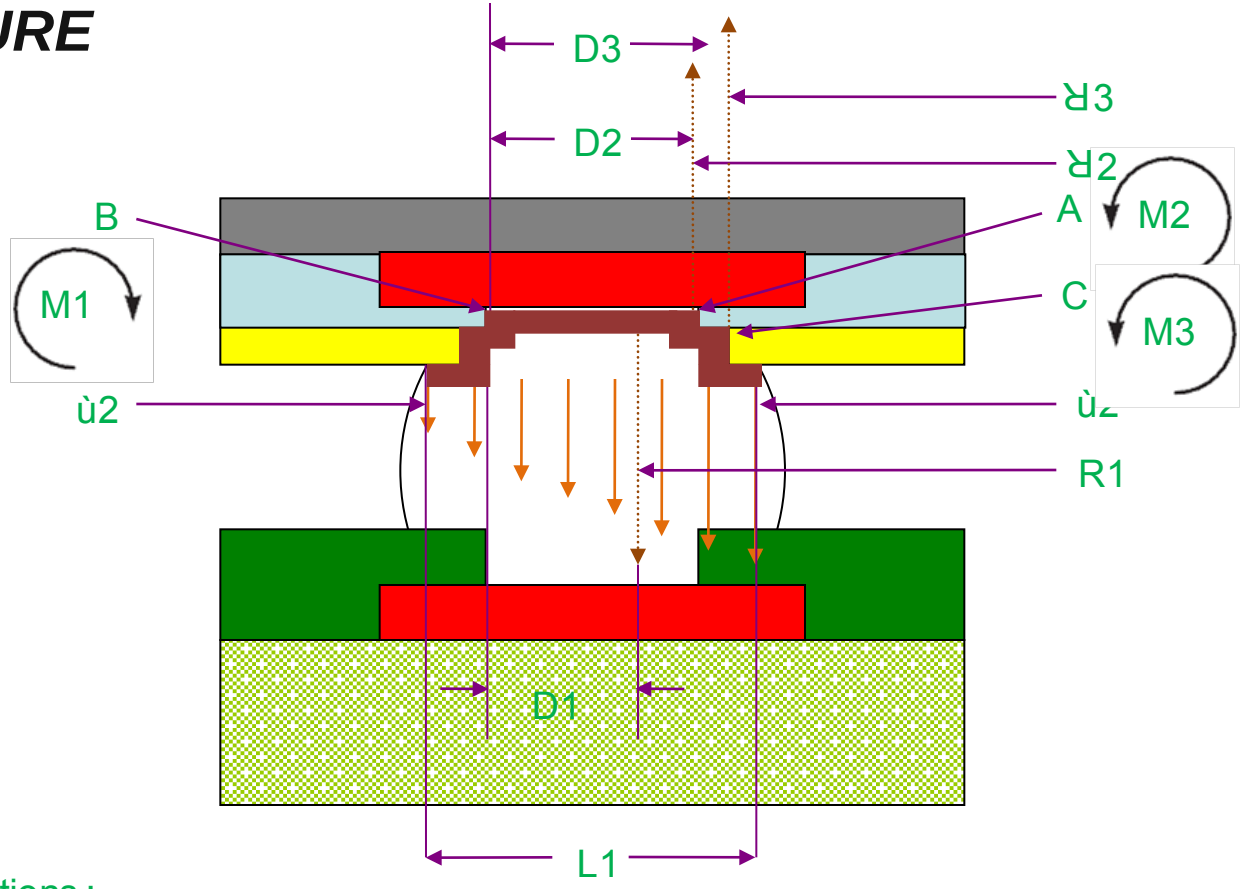
CROSS SECTION DIAGRAM OF A LADDERED-UBM SOLDER BUMP STRUCTURE



STRESS DISTRIBUTION ON A LADDERED-UBM SOLDER BUMP STRUCTURE.



COMPUTATIONAL MECHANICS ON A LADDERED-UBM BUMP STRUCTURE



Equations :

(1) M1 = R1D1
(2) M2 = R2D2
(3) M3 = R3D3
(4) M1 = M2 + M3
(5) R2/D2 = R3/D3
(6) R3 = R2D3/D2
(7) R2= R1D1D2/(D2^2+D3^2)

Given:

R1 = 10gF
D1 = 60um
D2 = 45um
D3 = 53

Computed solution:

R2 = 5.58gF
R3 = 6.57gF

ASSEMBLY AND RELIABILITY TEST CONDITIONS AND RESULTS

Test	Condition
Moisture sensitivity level	JESD22-A113/J-STD-020 LEVEL-4, 255+5/-0C reflow temp
Highly accelerated stress test (Unbiased)	JEDEC 22-A118; 130'C/85%RH33.5PSIG; 100H
Temperature cycling test	JEDEC 22-A104; -55'C~125'C; 1000 cycles
High temperature storage	JEDEC 22-A103; 150'C; 1000H; no preconditioning
Multiple reflow	255+5/-0C reflow temp, 5X to failure

Conventional UBM Solder Bump Structure

-Failed white bumps after assembly and during TCT

Laddered UBM Solder Bump Structure

- Passed assembly and all reliability tests.

SUMMARY

- Conventional UBM have higher stress due to higher reaction force produced by the bending moment due to the UBM lever effect.
- White bump failures happens if the stress is high enough if the supporting structure is not strong enough and the UBM structure lacks sufficient ductility to be able to flex and accommodate the bending moment.
- Laddered UBM structure could overcome such mechanism by introducing additional steps on the UBM to distribute the load produced by the lever-effect at a level that is not destructive to the structure.
- Computational mechanics has shown the advantage of the Laddered-UBM structure over the conventional structure
- Experimental data shows empirical data that the Laddered-UBM structure is far superior compared to the conventional UBM structure.

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