

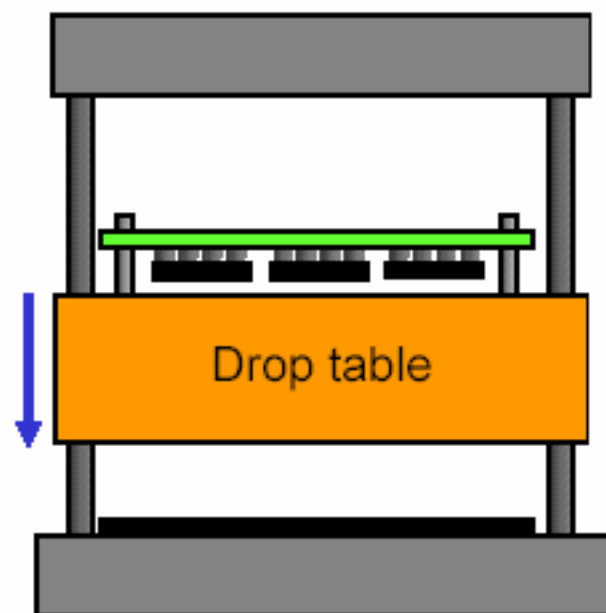
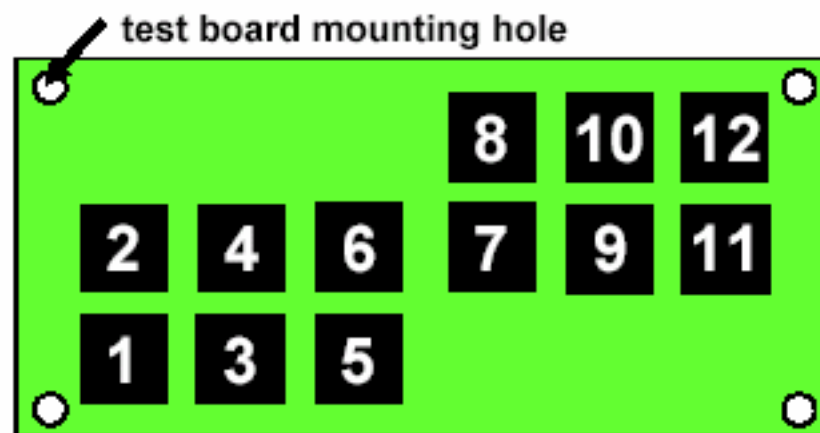


Effect of Thermal Aging on Board Level Drop Reliability for Pb-free BGA Packages

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Darvin Edwards, Kazuaki Ano

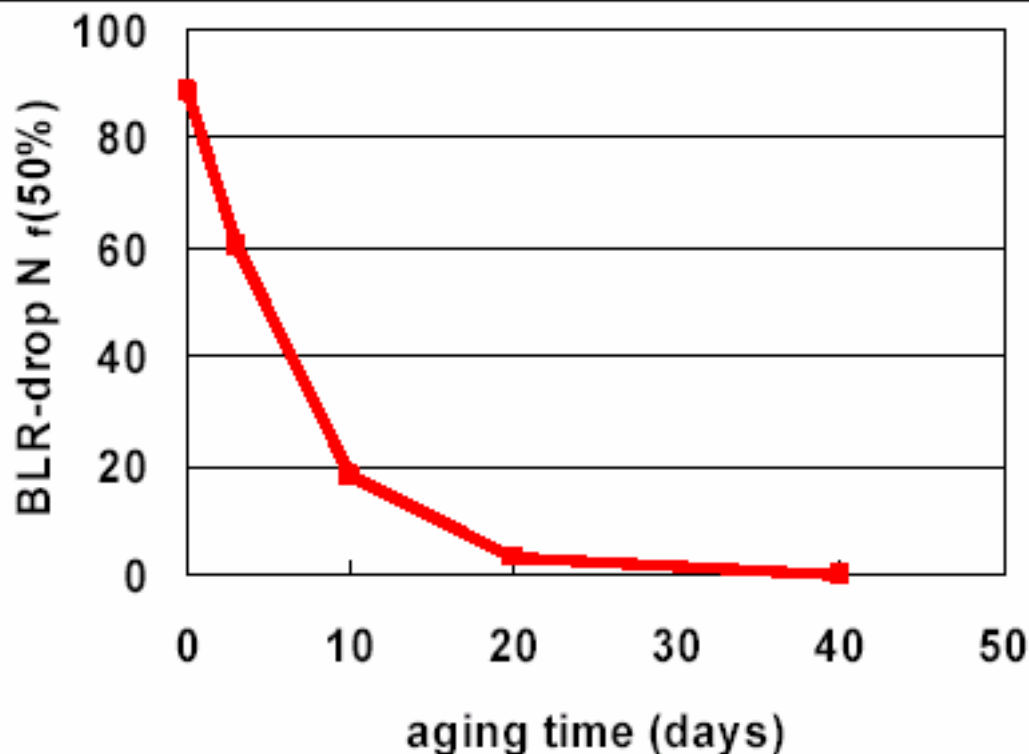
Texas Instruments

Drop test setup



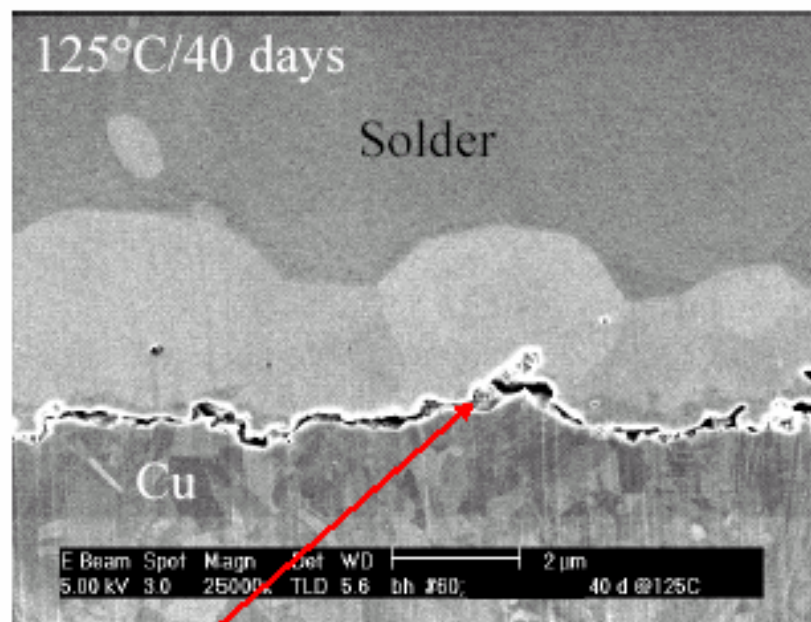
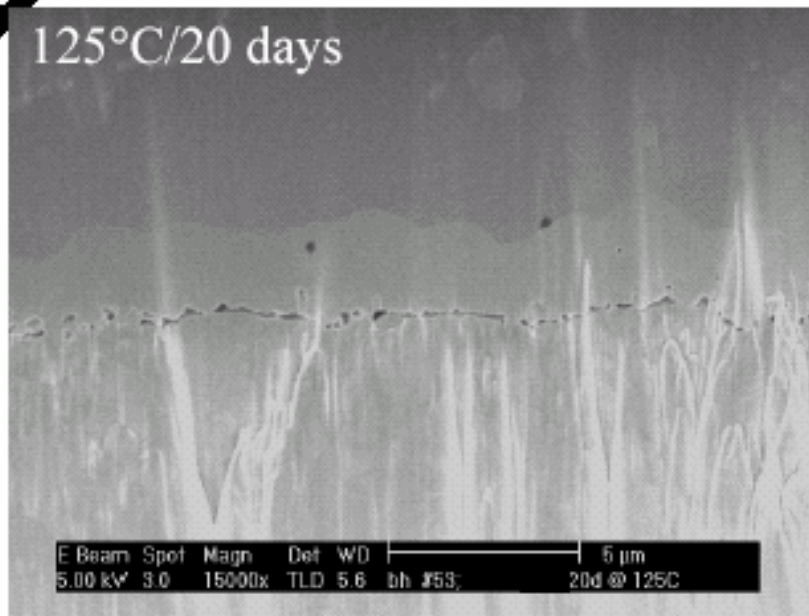
- **Test board:**
 - 12 plastic BGA packages with SAC solder joints
 - Units were monitored in situ with event detector
 - only data from units 6 and 7 were analyzed
- **Impact condition:** 1ms triangular-shaped acceleration pulse with 1500g peak
- **Thermal aging:** 125°C for 3, 10, 20 and 40 days

Effect of aging on BLR-drop

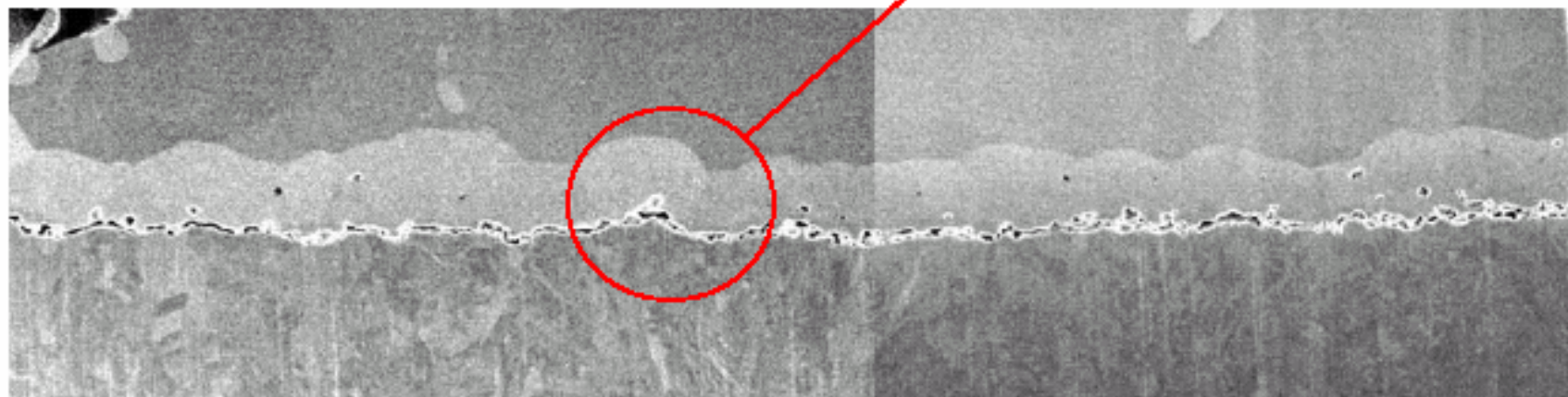


- Drop reliability degrades significantly after 125°C/10 days aging
- BLR-drop dependency on component location is not observed for the case of 40 days aging
 - All components failed within 2nd drop after 40 days aging

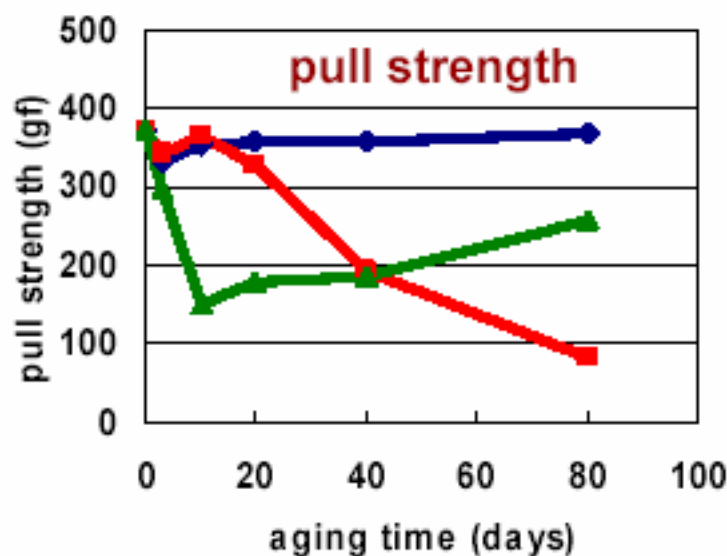
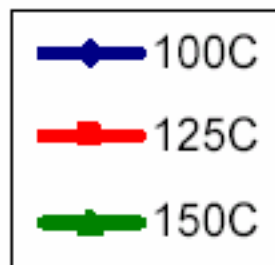
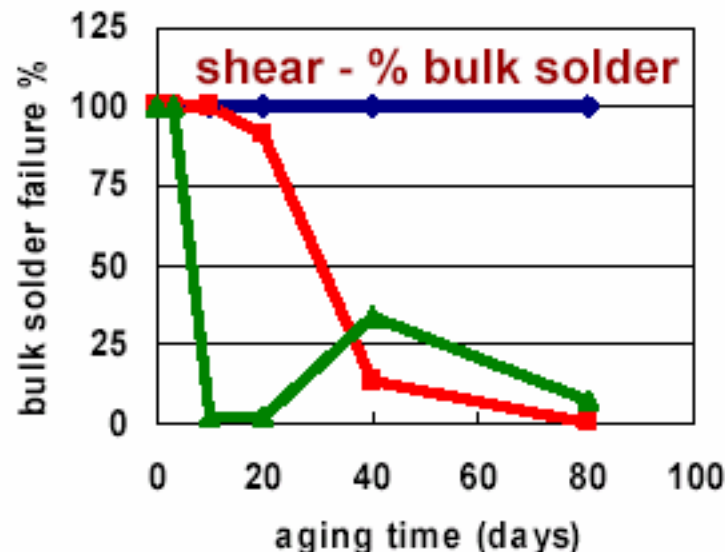
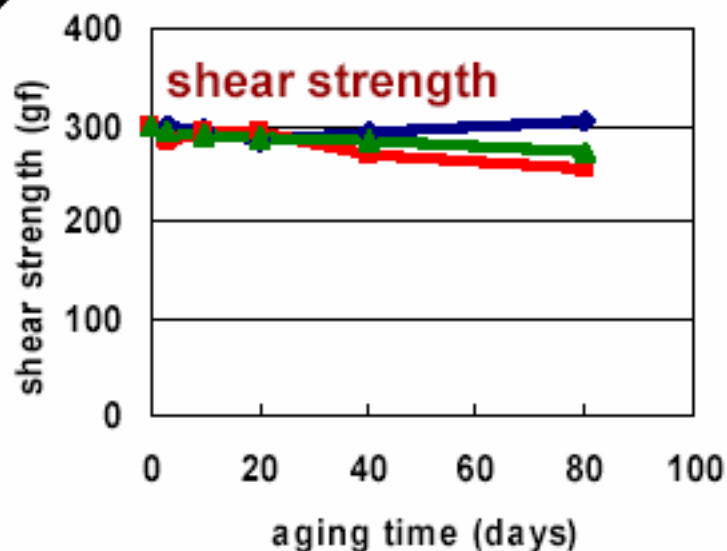
Cu/SnAgCu interface (125°C/20 & 40 days)



After 40 days at 125°C, the IMC layer was nearly separated from Cu



Comparison between voids, pull, shear and drop tests



Poor
Correlation



Summary

Very strong correlation between drop reliability and voiding for Cu/SnAgCu solder interface

- Kirkendall voids at Cu/Cu₃Sn interface are detrimental to the drop reliability after aging
 - Similar trend is expected for temperature cycling reliability
- Voiding process is activated at as low as 100°C
- Bare Cu or OSP-Cu surface finish is not suitable for higher temperature applications
- Ball shear testing does not correlate to drop test performance. Ball pull strength is not a good indicator of shock reliability either
 - The only parameter correlating to BLR-drop was the percentage of bulk solder failure in ball pull testing
 - Alternative component level testing technique is needed
 - ex, laser spallation, water jet impact, etc