Reliability Analysis of SnPb and SnAgCu Solder Joints in FC-BGA Packages with Thermal Enabling Preload

Pardeep K. Bhatti[1], Min Pei[2], and Xuejun Fan[1]
[1]Intel Corporation, M/S CH5-263, 5000 W2(S.8()t.T2 h Fa0)4.d5(l)4.er(-)5. B Cl l3,H 5

performance of solder joints. The test package and board design ensures that all solder joints in critical areas can be fully tested electrically. The dye & peel analysis provides an accurate measurement of solder joint crack area.

Experiment Results

FC-BGA test data with preload has been reported in [2]. The crack area as percentage of total solder joint area is plotted in Figure 2. It can be seen that the solder joint crack % area under the die region is relatively higher than at package corner when there is no preload is applied. This shows that critical solder joint is under the die region.

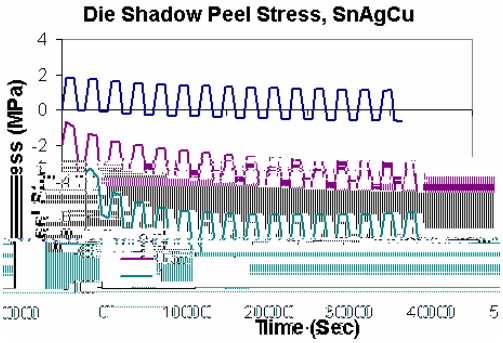
When compressive preload is increased to normalized value of 0.5, solder joint crack % area under the die region and at the package corner beco

where the support point is located is constrained in the vertical direction to simulate the fixture setup described in Figure 1. Three normalized preloads are investigated: 0 (no-preload), 0.5, and 1.0.

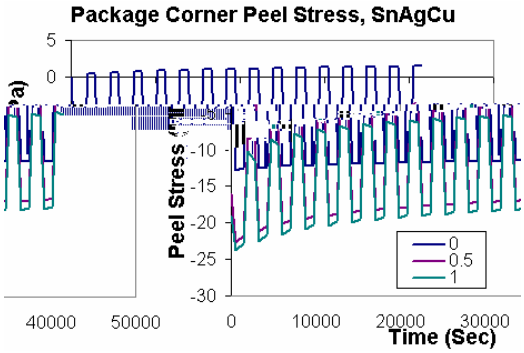
Thermal cycle range studied in the paper is -25 to 100°C. The dwell time is 15 minutes for both high and low temperatures, and the ramp up & down time is 8 minutes each. The total cycle time is 43 minutes. The preload is ramped up during a 1 minute interval at 100°C (to accelerate creep/stress relaxation at room temperature storage) and then thermal cycle loading is applied.

Table 1 Material Properties

life and can even change the failure location in the package. This analysis indicates that a more advanced fatigue law is needed for the preload case which accounts for both the conventionally used damage parameters (accumulated creep strain or strain energy per cycle) and the nature of peel stress in the solder joints. Such an enhanced model may even make life prediction for no preload case more accurate.



(a) Corner of die shadow



(b) Package corner

Figure 17: Peel stress history of SnAgCu solder

Summary

Empirical data shows that the existence of compressive