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Many studies on eutectic solder [1,2,3] have shown that the dwell time beyond certain limit has a minimal effect on the MTTF. Additional dwell time will not produce additional damage beyond a limit or boundary. However, our experiments consistently showed that the fatigue life of the lead-free solder balls decreases significantly when the dwell time increases from 15 minutes, to 30 minutes and until 90 minutes. Further failure analysis confirms that the failure mode and failure location is same when dwell time changes. The longer dwell time is, the more accumulated creep damage is. The results imply that it takes long time to entirely achieve the relaxation for the lead-frees solder material. In addition, results also showed that the lead-free solder joint during thermal shock fails faster than thermal cycling. The faster ramp rate does impose more damage on solder joint than a slow ramp rate. It is concluded that the ramp time and dwell time have conflicting effects on solder joint reliability. Finite element analysis is conducted to have a fundamental understanding of the effects of ramp rate and dwell time on lead-free alloys. A remarkable agreement on the correlation between the finite element analysis and experimental results was achieved. The numerical results revealed the failure mechanism of solder joint associated with the ramp rate and dwell time. Thermal shock has a much faster ramp rate, thus

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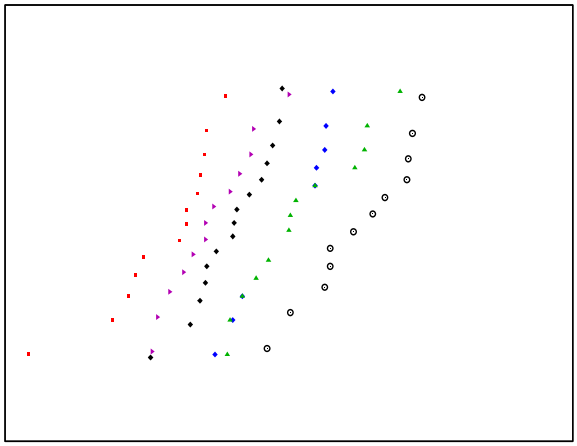
SnAgCu solder alloy to validate the finite element modeling results.



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