AREA Consortium

advanced process lab
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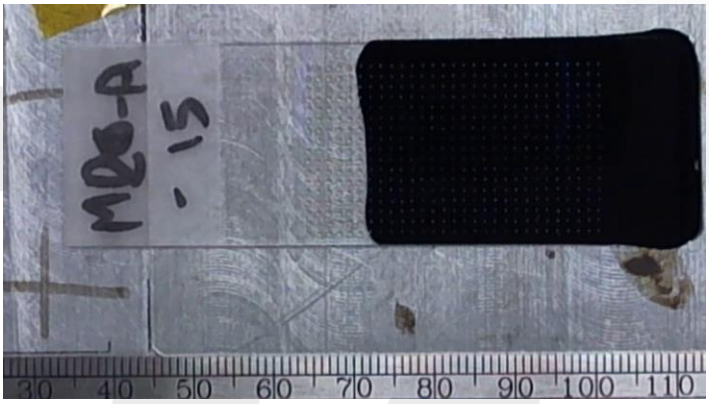
Dear Members,

We have had a very busy 1st quarter with a very successful February AREA meeting. It seems as though there were countless off-line meetings discussing research and future technologies and I am excited to report that our membership seems very engaged and committed to our 2014 Research Plan.

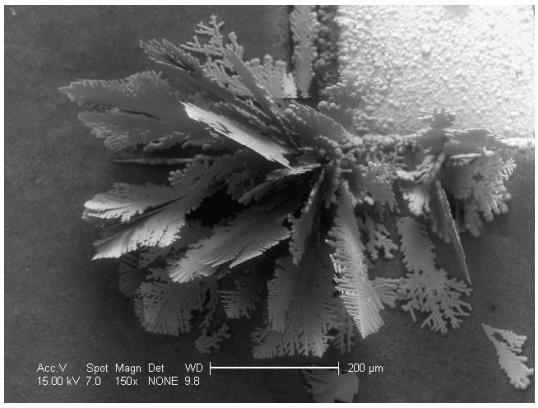
Martin Anselm, AREA Consortium Manager

MAT1A: Underfill Studies



Accelerated thermal cycling (ATC) of parts underfilled with material A continued. Some parts already have sufficient failures to allow comparison with non-underfilled assemblies. Failure analysis is planned to determine failure modes for the new samples and compare them with the failure mode of the non-underfilled parts. TB2013 boards were underfilled with material B as well and ATC of them has started, but no failures have been recorded to date. The timings for underfilling the parts on these boards were analyzed. The other two underfill materials (C and D) have been used in flow studies between glass slides. Different pastes, gap sizes, paste reflow conditions, and underfill temperatures have been used. The flow rates at different temperatures were used to extract the activation energy for the flow process. Other flow-related observations were correlated with parameters including paste reflow profile and reflow ambient.

REL4A: Creep Corrosion



Several sets of experiments were performed in the FoS chamber, using all 6 finishes of TB2013 plus Immersion Silver. The corrosion of coupons after a 20-day exposure at 60°C and 82% RH was studied, with special emphasis on creep corrosion. In two of these experiments chlorine gas was introduced as an additional corrosive constituent of the ambient inside the chambers. Two substances that often appear as components of industrial dust were investigated as contaminants. Finally, the effect of aggressive cleaning of the coupons before exposing them to a corrosive atmosphere was investigated.

MAT4A: Thermal Performance of Gap Pads

We've completed the study "Component level Characterization of Gap Pads". The results were presented at the February AREA Consortium meeting and the talk is available on the APL website. The final report for this work will be available shortly. Due to member interest, we plan to repeat the high temperature storage portion of the test with a fixed bond line thickness. This test is currently underway. There are two additional TIM projects planned for 2014. The first project will focus on characterization of Phase Change Materials (PCMs) TIMs. We will use the same test vehicle developed in the "Component Level Characterization of Gap Pads" study to characterize the thermal resistance as a function of pressure and temperature. If you have a specific PCM you'd like us to characterize please contact Harry Schoeller (Harry.Schoeller@uic.com). The second study involves the effect of TIM compression of BGA reliability. BGAs will be loaded under various pressures from 10% to 60% gap pad compression then undergo thermal cycling and high temperature storage.

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MAT6A: High Temperature Solder Joint Reliability

Six high temperature alloys will be evaluated, four Pb-based alloys and two Pb-free alloys. A list of the alloys is provided below. Alloys will be evaluated as interconnects for surface mount resistors and capacitors. The microstructure will be studied in the as reflowed state and after long term thermal storage at 200°C. Likewise the shear strength will be evaluated after reflow and after long term thermal storage. After shear testing the fracture surfaces will be analyzed to determine the mode of failure. The thermal-mechanical fatigue behavior will be assessed through ATC and thermal shock tests with in-situ monitoring of surface mount resistors. Failed samples will be removed from the chamber after failure to determine the failure mechanism.

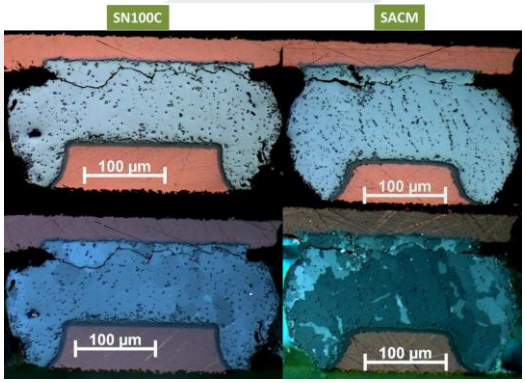
Composition	Liquidus (°C)	Solidus (°C)
92.5Pb-5Sn-2.5Ag	296	287
95Pb-5Sn	312	308
92.5Pb-5In-2.5Ag	310	300
85Pb-10Sb-5Sn	255	245
90Sn-10Sb	252	242
Bi-Ag-X	-	262

MAT7A: New Alloy Research Drop Test

New drop test board was designed in order to evaluate the reliability performance of various solder alloys. The boards were recently delivered to us. If you have any specific alloy in mind that you would like to be evaluated in drop test, please contact Babak Arfaei @ babak.arfaei@uic.com.

The results of ATC tests showed similar trends as observed in the shear fatigue test. Results suggest the recrystallization and failure mechanism in Pb-free solder joints are strongly affected by Ag3Sn precipitates. Performance of mixed alloys (SAC 305 ball+ SnPb paste) in thermal cycling test was investigated as well. Large variations in performance of mixed alloy were observed depending on the surface finish.

Microstructure investigation is in progress to better understand the effect of Pb and dopant addition to ATC performance of lead free solder joints constructed on different surface finishes. Samples subjected to percentage of N63 are currently being cycled. Analysis of those samples will help us understand the microstructure evolution during ATC test.



Optical micrographs with cross polarizer image of components constructed with 10 mil spheres assembled on Cu/ENIG surface finishes. Cracks were observed near the component side. Recrystallization and intergranular crack propagation was observed for Pb-free alloys.

REL3B: Vibration Reliability

We have completed preliminary testing of VTV (Vibration Test Vehicle) boards to identify failure modes and test parameters (vibration level, test duration, etc). The configurations tested were BGA and LGA, with SAC105 and SnPb solders. In these tests we limited the test duration to 4 hours at 2g base acceleration, driven at first resonance using harmonic resonance tracking. All 16 tested boards showed failed board traces, and 7 had full solder joint fatigue failure. All tested boards had evidence of solder fatigue, suggesting that continued testing would have resulted in fatigue failure. New boards have been assembled (20-BGA SAC105; 20-BGA SnPb; 16-LGB SAG105; 17-LGA SnPb). We will be testing these boards until detected solder failure (beyond 4 hours each if necessary).