AREA Consortium

May 2014 Newsletter

Dear Members,

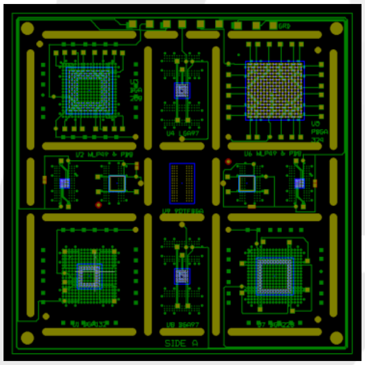
The Steering Committee (SC) is working on some proposals for research for 2015. I am very excited that the SC is getting an early start on planning since some of these proposals will be shared with you during our September Member Application Planning (MAP) sessions. Our June Meeting agenda was sent out last week and we have another content rich series of presentations planned, outlining the progress on many of our 2014 projects.

On May 14th I had the opportunity to present the Keynote presentation at SMTA's ICSR Conference in Toronto. The presentation was a review of North American consortia that focus their research on electronics packaging and manufacturing. A copy of the presentation can be found at our website www.uic-apl.com. I feel that our AREA Consortium provides a unique service to the industry unlike any other and I am proud of the efforts of our staff and our Members in making it a success.

I look forward to seeing many of you on June 11th and 12th!

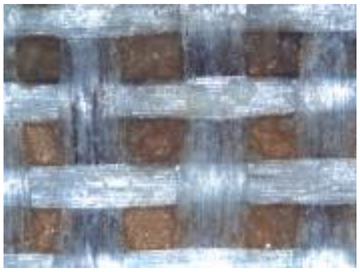
Martin Anselm, AREA Consortium Manager

MAT1A: Underfill Studies



Assemblies underfilled with material A are still being cycled, with some of the parts having still only a few failures after 2300 cycles. The material B samples have surpassed 1000 cycles with no failures encountered except in one of the parts. TB2013 boards were underfilled with materials C and D and ATC of them has commenced. All materials have been used in flow studies as well, so the first phase of the project is approaching its end. A new test board (TB2014) has been designed and ordered. Unlike TB2013, this board will be dedicated to underfill studies. The materials to be tested with it have yet to be decided.

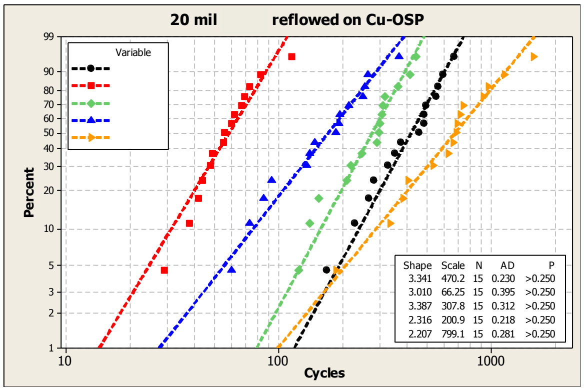
MAT10A: Laminate and Glass Studies in Pad Cratering



A new set of boards containing circular NSMD pads of several diameters has been acquired and Hot Bump Pull at an angle strength measurements of them have started. The pads have been arranged in such a way that they will facilitate subsequent analysis for correlating strength with pad location relative to the glass weave. The glass weave of the new boards is very different from the weave of the older samples made of the same laminate.

MAT7A: New Alloy Research

We have performed room temperature shear fatigue test on 10 different solder alloys (all 20 mils on Cu surface finish). The results of room temperature fatigue testing of various solder/Cu joints showed distinct dependences of fatigue lifetime on solder composition. Distinct increases in lifetimes with increases in Ag content were observed in SAC/Cu solder joints.



Weibull plot (right) showing the room temperature shear fatigue results of 20 mil spheres reflowed on Cu-OSP surface finish. Shear fatigue results were sensitive to solder composition.

REL2A: Lead-Free Phenomenological Model Update

A unique experiment has been developed and validated which has allowed us to validate our model for the life of SnAgCu solder joints in thermal cycling. Ongoing improvements to the experiment will allow us to finalize a quantitative version of the model. Current expectations are that a more comprehensive unified model will eventually apply to both thermal and isothermal cycling, but this will have to await the completion of current and planned TEM analysis. We have previously shown the rate limiting mechanism for the evolution of damage and failure in thermal cycling to be the formation of a continuous network of high angle boundaries across the high strain region of the joint. It was concluded that if we can predict the number of cycles to the completion of this recrystallization, we can predict the life.

Based on this and previous work we believe to have reached a complete mechanistic understanding of life in thermal cycling, including all the factors that need to be accounted for in a quantitative formulation of the model. What remains is a series of systematic experiments with specially prepared assemblies in the same type of experiment to quantify parameters needed to predict precipitate coarsening and the interacting effects of this, stress, work and temperatures on recrystallization.

REL3B: Vibration Reliability

Vibration testing of the Vibration Test Vehicle (VTV) assemblies continues. There are four assembly configurations to test two component types (BGA or LGA) and two solder types (SnPb or SAC105). Each board is tested using harmonic vibration with resonance tracking until electrical failures occur. The primary identified failure mode is solder fatigue at the corner joint. Results are summarized below.

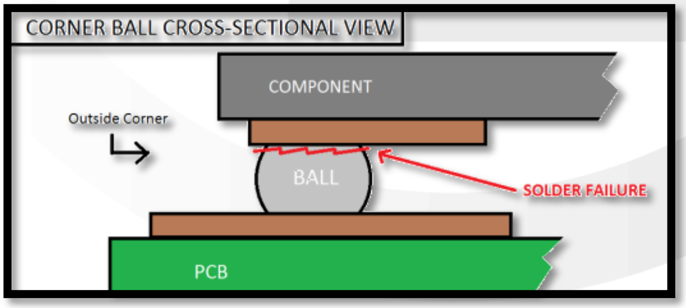
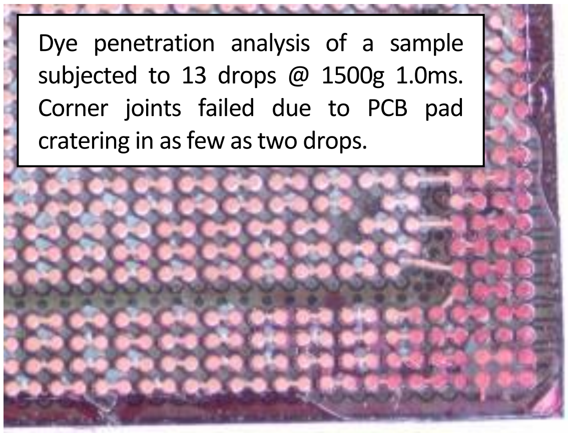


Illustration: Typical Solder Failure in Vibration testing of BGA devices

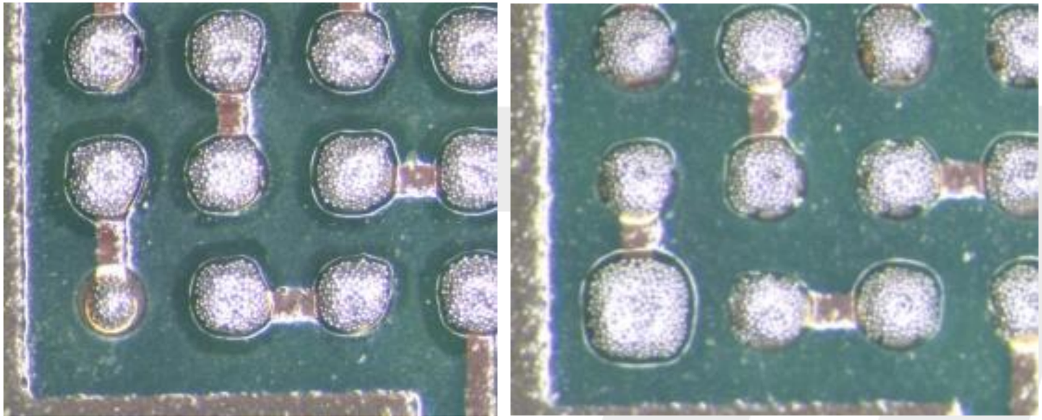
REL10A. Drop test JESD22-B111 Redesign Evaluation


Dye penetration analysis of a sample subjected to 13 drops @ 1500g 1.0ms. Corner joints failed due to PCB pad cratering in as few as two drops.

We continue to evaluate the proposed revisions to the JEDEC drop test standard. Comparing boards dropped to 1500G 1.0ms pulse duration to boards dropped to 1500G 0.5ms pulse duration show that the longer pulse duration may reduce drops to failure by a factor of 3. Both tests have produced failure by printed circuit board pad cratering. Currently we are studying ways to control the drop tester velocity change which is approximately 320in/s on our equipment, but only ~200in/s on the equipment being used by the JEDEC committee.

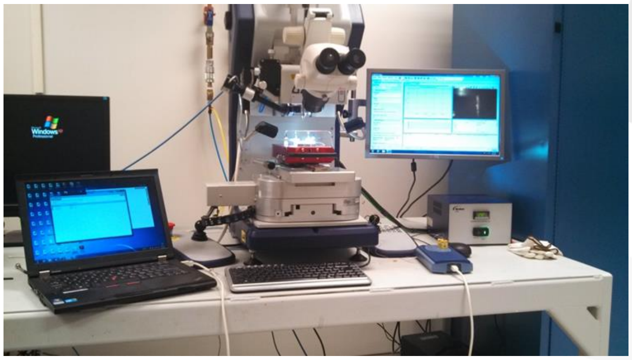
REL6A. Print Correlations to Reliability

We have begun a systematic study on the effects of solder paste deposit size on BGA and CSP reliability. This project is unique because we are intentionally producing paste deposits which are severely undersized or oversized at the solder joint locations that tend to fail when subjected to thermal cycling while maintaining 'typical' paste deposits at the other locations. We already have results for a CSP device subjected to which will be discussed at the June AREA meeting.



Paste prints for a WLCSP assembly with undersized and oversized deposits at the corner joint locations.

MAT6A: High Temperature Electronics Research



We've developed a test methodology for high temperature isothermal fatigue testing of individual solder joints. Testing was carried out on the Dage 4000plus system with a heated stage as shown in the figure below. Both the board and solder joint temperatures were measured continuously during testing. High temperature isothermal fatigue testing of 92.5Pb-5Sn-2.5Ag at 200°C has been completed. Testing of other high temperature alloys is ongoing. Initial results from this study will be reported at the meeting next month.

MAT4A: Characterization of Thermal Interface Materials

We've completed thermal characterization of gap pads after high temperature storage with a fixed bond line thickness (BLT). This is a follow up study to "Component Level Characterization of Gap Pad" where the thermal resistance of commercially available gap pads was measured under continuous loading. In the current study, lock collars were fastened under the springs after loading, fixing the spring displacement, and BLT. The fixtures were then stored at 125°C for 1000 hours. After thermal storage the thermal resistance was measured at 50W. These results will be compared to high temperature storage under continuous load.

We are also characterizing Phase Change Material (PCM) Thermal Interface Materials (TIMs). PCMs are a class of TIMs that experience a change in viscosity above the "phase change" temperature. The change in viscosity may be abrupt or gradual depending on the type of resin used. Once heated above the phase change temperature the PCM fills in surface asperities lowering the contact resistance. Further there is a decrease in BLT, lowering the bulk thermal resistance. We are utilizing our variable loading component level TIM tester to characterize the thermal resistance of four commercially available PCMs. PCMs will be characterized as a function of power dissipated and pressure. Initial results will be presented at the June meeting.