AREA Consortium

August 2012 Newsletter

Dear Members;

October Meeting: 3rd and 4th! **MARK YOUR CALENDARS!**

I am pleased to announce that we have added The Binghamton University ME Department to our fall efforts. Both Dr. Quang Su and Dr. James Pitarresi along with 3 students will help us with our laminate evaluations, drop & vibration tests and modeling efforts. Dr. Peter Borgesen and his team from the SSIE department continue to be funded and will be highlighting their research advancements in October.

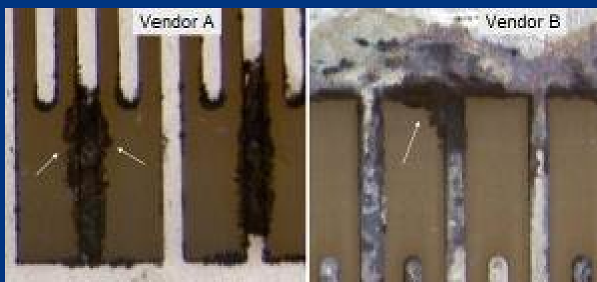
We would like to announce that Dave Vicari has been promoted to Director, Advanced Process Lab, replacing George Westby in that role. Dave has been at Universal for over 20 years and most recently served as Project Manager for the Process Services Group. Dave's support of the AREA Consortium, experience and expertise in manufacturing will continue to be a asset for the AREA Consortium in project development and implementation.

All the Best,

Martin Anselm, Manager AREA Consortium

Creep corrosion by FoS (flower-of-sulfur) testing

Contamination by chloride ions of 7 ug/in2 was shown to accelerate creep corrosion on various surface finishes from several vendors. The finishes were Pb-free HASL, Cu-OSP, ImmSn, direct Pd coating and a nano-coating. A comparison between MFG (mixed flowing gas) test and FoS test was conducted on one ImmAg test vehicle with various fluxes/pastes and chloride contents. The results showed that MFG test, being more corrosive, did not always result in faster creep corrosion.



ImmSn test vehicles contaminated by 7 ug/in2 chloride ions showed creep corrosion in FoS test.

Website Updates

- New reports have been uploaded!
  - 0.3mm process and Reliability
  - Epoxy flux process and reliability
  - HT Die attach
  - LGA vs BGA Bend test reliabilty

LF Damage Accumulation

Our studies of fatigue under variable amplitude loading conditions continue with the collection of statistics on the observed trends. Preliminary indications are that the damage accumulation effects may depend significantly on the strain rates. Collection and analysis of systematic data should also allow us to predict combinations of loading that lead to the largest deviations from Miner's rule. Experiments are in progress to test predictions

LF ATC Reliability

Dr. Peter Borgesen's ongoing investigations regarding BGA and CSP thermal cycle reliability scaling factors is now well underway. We have already completed three of the first four thermal cycle tests and are expecting to begin the next four cycles in a few days.

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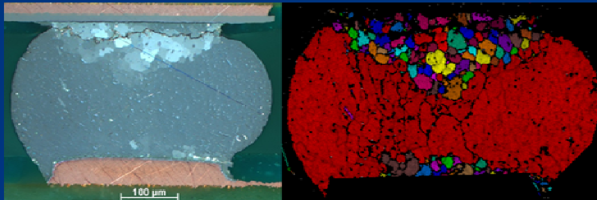
Lead-Free Research

We continue our research on the failure mechanism of lead free solders in thermal cycling test. Both harsh (-40/125 C) and mild (20-80 C) cycles have been characterized. The goal is to understand the physics of failure. Various aspects of microstructure such as grain orientation, precipitates size and distribution have been investigated



The figure shows the cross-polarized image of a BGA sample failed in thermal cycling, the EBSD analysis shows the formation of new grains with random orientation.

New Alloys

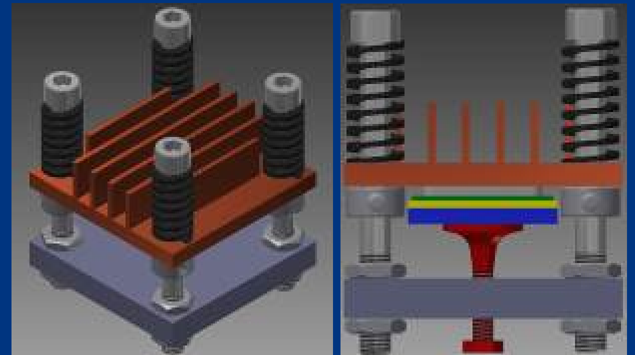
The work is in progress to evaluate the properties of "New alloys". Different solder alloys with various amounts of dopants are being considered. The effect of size on the microstructure as well as the microstructure evolution as a function of aging are being evaluated.

0.3mm pitch BGA Reball Project

We've developed a rework process which includes component removal, site cleaning, flux printing, and stencil reballing. All rework for the rework assemblies has been completed. After developing a paste dip process, the reworked components will be reassembled. Drop testing and accelerated thermal cycling of the reworked and virgin assemblies should begin next week.

TIM Characterization

We've received Thermal Test Vehicles (TTV) and sample TIMs. A TIM loading fixture has been designed (see figures below) and will be built the first week of September. A load calibration fixture is also being designed to accurately determine the applied pressure. Initial characterization of sample TIMs will begin in September.



Fine Pitch Filled vs. Unfilled Vias

Our evaluation comparing open and copper filled PCB via-in-pad designs for fine pitch (0.3mm to 0.5mm) components is nearly complete. Samples subjected to test in our -40/125C thermal chamber have surpassed 1000 cycles and we have sufficient data for comparing 3 out of 4 of the primary device types. Analysis shows that the open via-in-pad dramatically reduced the reliability of a solder mask defined PCB assembly because the mask definition resulted in solder failure at the board side of the joint. Devices which failed at the component side of the joint weren't significantly affected by the via structure. Failure analysis also indicated that open via structure may have been more likely to crack (but not fail) than the filled via structure in thermal cycling. We also have significant drop test data on these assemblies, which will be discussed at the October AREA meeting.

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0.3mm Print Studies

The PCBs for our 0.3mm pitch WLCSP test vehicles have finally arrived and we are in the process of acquiring several stencils including Laserjob's PatchWork step stencils for printing evaluation. We have also produced a paper for SMTAi discussing some of our work with 0.3mm pitch components including recent assembly and reliability testing using a member supplied test board and device. The paper has been made available on our website.

50micron Thin Die Update

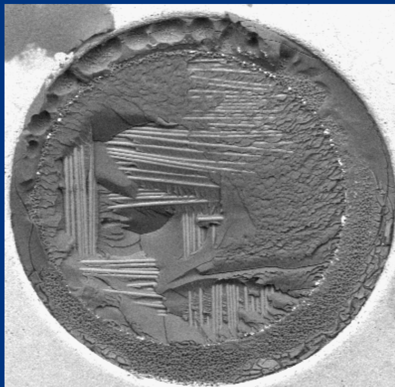
The testing of thin die 0.45mm pitch WLCSP using -40/125C thermal cycling is nearly complete. Variables evaluated included stencil thickness, aperture dimension and solder paste type (3 vs. 4); but the biggest factor affecting reliability was PCB pad diameter which was found to nearly double the lifetime of the assembly when a 7 mil diameter pad was used in place of a 9 or 11 mil pad. Failure analysis is in progress.

Pad Reliability at Various Loads

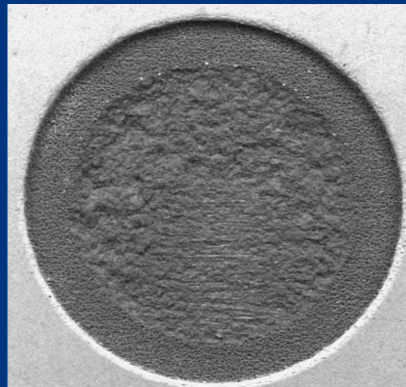
The strength tests have been concluded for all 3 board types and 7 pad sizes. Fatigue tests have been performed for 4 of the pad sizes at 70% of the average strength corresponding to each board type and pad size.

- **Fatigue tests at 60% of the strength have started**
- **More boards have been built for future experiments**
- **Analysis of the results of the strength fatigue tests is ongoing**
- **The failure surfaces of selected pads are examined in more detail, both photographically and with SEM.**
  - **Example below: Typical 24-mil-pad failure surfaces after strength tests**

Pad Reliability at Various Loads



Nelco



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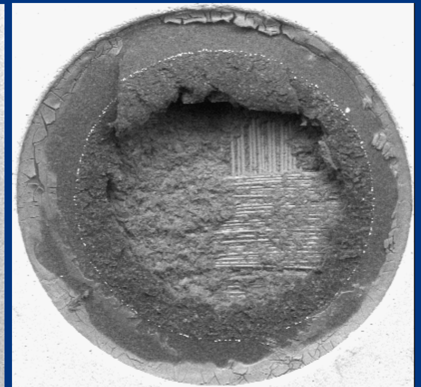

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