advanced process lab
research • process support • analysis

AREA Consortium

Dear Members,

Execution of our 2015 research plan is well underway. A few projects have an expected delayed start pending the arrangement of collaborative participation from interested member companies. These include the Conformal Coating and Power Cycling projects, among others.

We have historically reserved our March meeting for the formal year end reporting of the previous year's projects. Because our Fall meeting last year was delayed to accommodate the PERM meeting schedule, we were able provide final reports for many 2014 projects in November. Consequently, the upcoming March meeting will include some of the new 2015 content. A few of these projects are already through the design and hardware build phases. In those instances our discussion may revolve around the planned experimentation rather than testing results.

For those of you attending the APEX show in San Diego this month, please stop by the Universal Instruments booth on the exhibition floor and say hello to Denis Barbini and Dave Vicari. They'll be showcasing our process laboratory capabilities alongside the latest Universal assembly machines

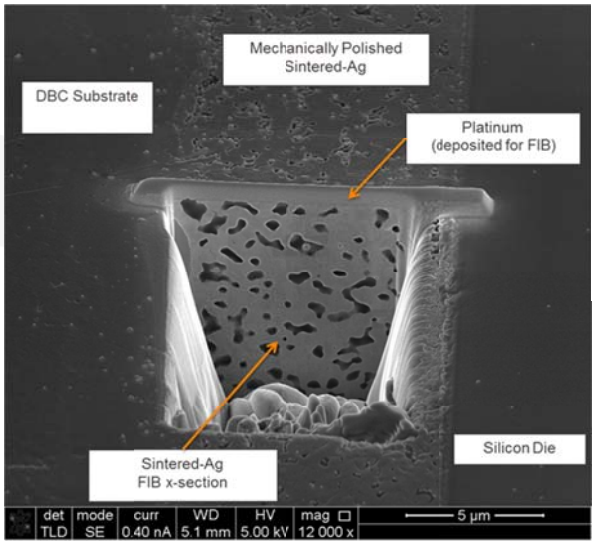
Sincerely,

Jim Wilcox
Consortium Manager

MAT6B. Die Attach and New Pb-free Alloys: Sintered-Ag Die Attach Material

In November we reported on an initial assessment of sintered-Ag die attach material. We examined the effect of maximum sintering temperature on porosity and the effect of surface metallization on the interfacial reactions. An image of a sintered-Ag joint cross sectioned using focused ion beam is shown here. The die shear strength of this sintered-Ag die attachment has been compared to a high-Pb solder control sample as well as a commercially available Bi-based die attach alloy.

Currently we are studying the reliability of sintered-Ag die attach in high temperature thermal shock (-50°C to 200°C) and in high temperature storage. The accumulation of fatigue damage during thermal shock is being documented by x-ray inspection and metallographic cross-sectioning. Samples are being periodically removed from the chamber to measure the degradation of shear strength. Results will be presented at the March consortium meeting.

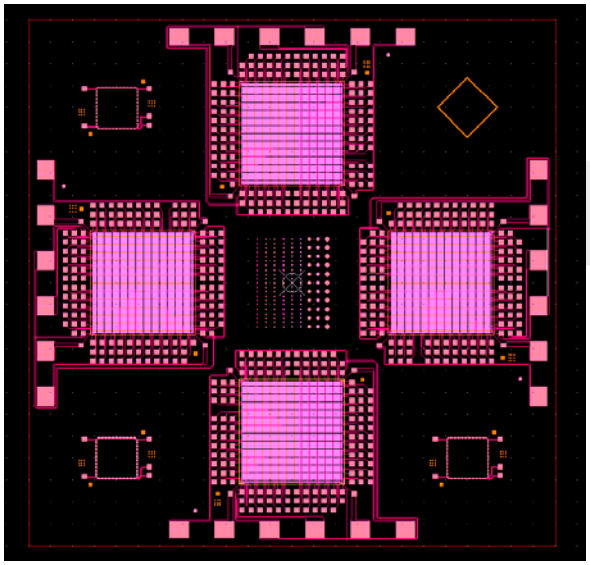


Vibration Test Capability

We have acquired a new vibration testing system. This enables us to perform various vibration experiments (sine, random, *etc.*) on-site at Universal. We plan to continue vibration studies using the methodology that we developed last year (REL3A) with emphasis on testing of various solder alloys and interconnect configurations (BGA and LGA). Performance of sequential ATC and vibration tests is planned as well. If you are interested and would like to get involved please contact Babak Arfaei.

REL12A. Fine-Pitch Cu Pillar Interconnect for 2.5D Packaging

The Cu pillar research project is a collaborative effort involving the AREA Consortium, IBM, Corning and Binghamton University. It will examine the assembly characteristics and reliability behavior of fine pitch interconnects to be used in highly integrated 2.5D packaging structures, particularly those using glass interposers. The design of test vehicle is complete. Cu pillars ranging from 30 to 150 µm diameter (pitches 90 to 240 µm) are included in the design.

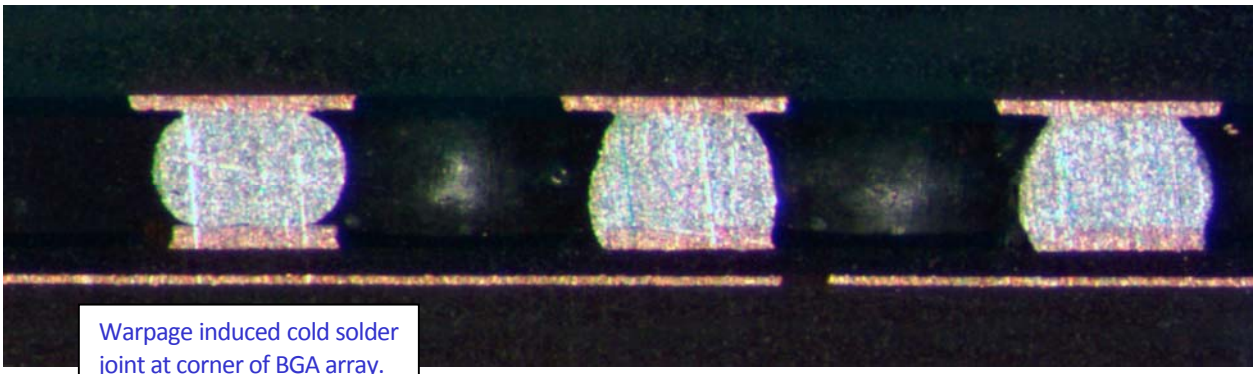


Vehicle to test four sites with Cu pillars of 90 um diameter

IBM is in process of obtaining the lithography masks to fabricate the various test wafers and metallize the glass interposer substrates. 2.5D packaging test structures will be assembled in our laboratory. ATC and drop/shock testing will be performed. Preliminary results and project plans will be presented in March AREA meeting.

APD9A. Warpage Contribution to Head-on-Pillow Defects

We have produced a first set of dummy BGA components for our Head-in-Pillow analysis and are busy characterizing their warpage behavior as a function of temperature. We have also assembled a handful of these devices to determine if we can indeed produce warpage induced Head-in-Pillow defects. The purpose of this project is to provide experimental data to support the idea that the current JEITA and JEDEC specifications for BGA warpage are too liberal by demonstrating that packages within the allowable 0.17 to 0.23mm warpage range can produce the HiP defect. So far, we have been able to produce cold joints with components assembled using a flux-only process on setup boards. Going forward, we believe that some minor changes to our designs can yield components with 'in-spec' warpage characteristics that will indeed produce HiP defects with a paste printing process. With such data we can support efforts to revise the industry standards on allowable BGA warpage.



Warpage induced cold solder joint at corner of BGA array.

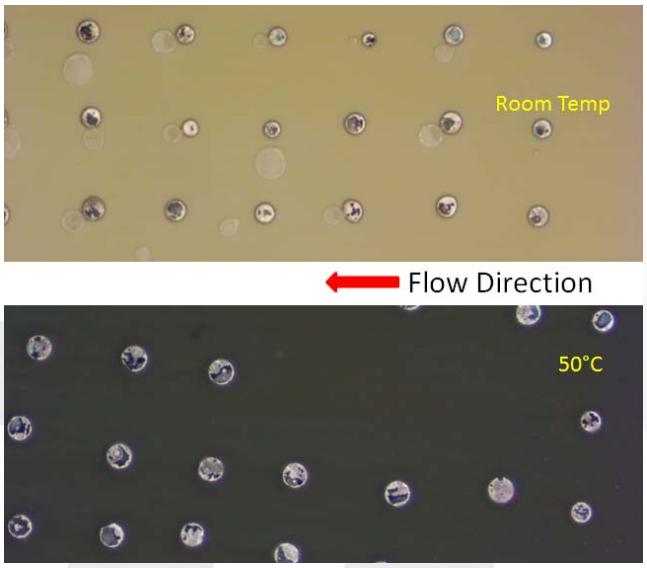
AREA Consortium

Underfill Studies

MAT1A. Underfills and Adhesives:

The ATC testing of underfilled assemblies on TB2013 is about to be concluded. Thermal cycling of parts underfilled with material B was discontinued after 6,000 cycles with two component types still without any failures. Cycling of the remaining samples will be discontinued soon.

Enough failures have occurred in the Underfilm evaluation samples to allow ranking of material choices, but thermal cycling is continuing.

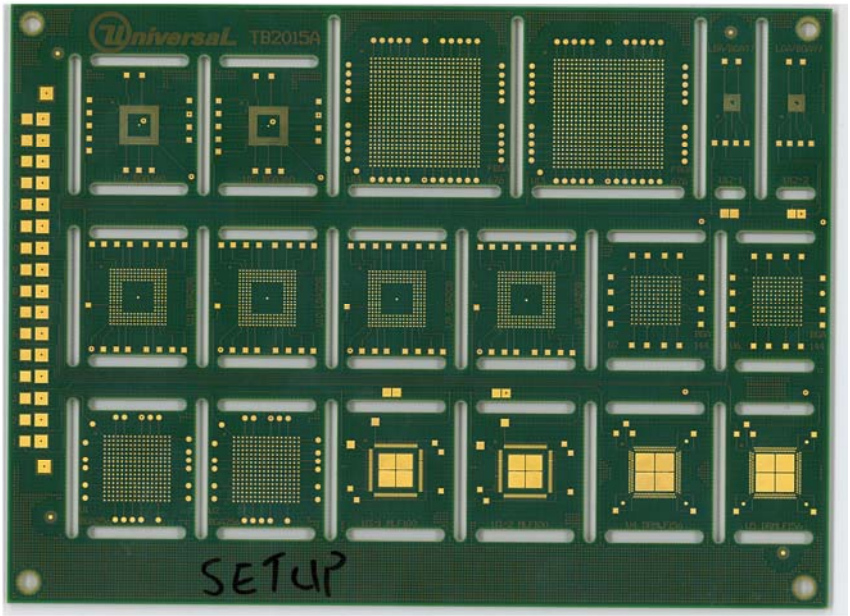


MAT1B. Reworkable Underfills:

The list of reworkable underfills to be used with TB2014U has been finalized and the materials have been requested. The first have already arrived and preliminary paste compatibility and flow tests (between glass slides) have started. Difference in the voiding behavior were seen in material E when it was dispensed at room temperature (many flow voids) and elevated temperatures (almost no voids). Assembly of the first group of boards is scheduled before the end of February. The possibility of expanding the test matrix to include SnPb components and cleaning before underfilling is being explored because of the expressed interest of several Consortium members.

Test Board 2015

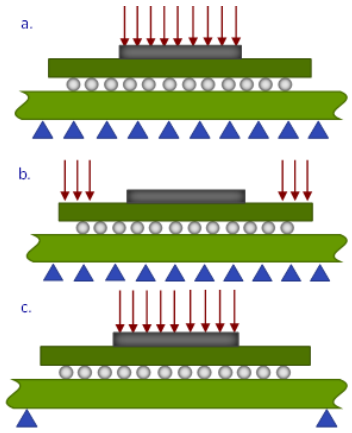
Test boards of the TB2015 design have been procured with both ENIG and Cu OSP surface finishes. The board contains footprints for BGA, CSP, QFN and SMR assembly and was designed for our conformal coating and solder alloy experiments. The design files, in Gerber format, have been posted to our website.



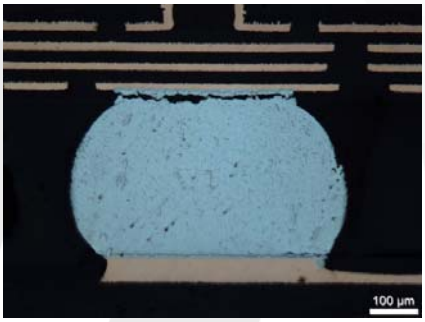
Component	Pitch (mm)	Body Size (mm)
CVBGA360	0.4	13
PBGA676	1.0	27
CVBGA97	0.4	5
CABGA208	0.8	15
CABGA144	1.0	13
CABGA256	1.0	17
MLF	0.4	12
DRMLF	0.8	10

AREA Consortium

REL11A. Effect of TIM Compression Loads on Component Reliability



This experiment studies the effect of superimposed compression loads on BGA reliability in thermal shock -40/125˚C. The superimposed loads vary up to a pressure of 5MPa to produce 90% TIM compression. In addition to varying the magnitude of the superimposed compressive load, different loading and support configurations are also being evaluated as shown in the left figure. Testing has progressed through 1800 cycles of thermal shock. Roughly 25% of the samples have failed. A cross-section image of a failure (loading condition b, 90% compression) is shown on the right. Results from this work will be presented at the March consortium meeting.



90% compression fail, edge loaded

Pad Cratering Studies

MAT2A. Circuit Board Materials

Thermal cycling and conductive anodic filament (CAF) testing of specially made coupons with the same hybrid lamination structure as previous pad cratering substrates continues in order to test whether these composite structures can survive multiple reflows. Other coupons for testing the effect of Cu pad roughness on pad strength along with the required balling stencils have been received. We're planning for Hot Bump Pull testing before the end of February.

MAT2C. High Tg PCB Laminate Materials

Testing of the pad strength of circuit boards using Cold Bump Pull before and after 6X Pb-free reflow has started. The test involves 11 different laminate materials, each in a low-resin and high-resin version. In the first round, 12 pads from each of two nominally identical coupons are pulled for each combination of laminate material, resin content, and reflow history. If better pad strength statistics prove necessary, more pads will be pulled in a second round, up to a total of 50 per combination. The failure surfaces are studied using optical and SEM imaging.

REL6A. Effect of Paste Print Variability on Reliability

Our efforts to better understand the effect that individual solder paste deposits play in long term interconnect reliability tests continues. We have recently assembled CSP, LGA, SMR and QFN samples with paste prints that contain strategically located deposits that are 25% to 75% lower in volume than nominal. For one LGA design we found that a 50% reduction in paste volume (at a single pad) resulted in low assembly yield while another LGA design quickly failed in thermal cycling. Ultimately, we hope to provide reasonable paste volume tolerances for the various part types to ensure both high yield and acceptable reliability.