AREA Consortium

Dear Members;

We at the AREA Consortium hope you all have enjoyed your summer vacations! Now we must get back to reality and focus on the fast approaching September 24-26 AREA Consortium meeting. As you may be aware we are planning a reunion event with our former members and students.

We have David McCann, Vice President, Packaging and R&D, GLOBALFOUNDRIES providing a keynote address entitled, "Trends in the Development and Implementation of Interconnect and Packaging Technologies" on Wednesday morning. We hope to see you all there! In order to RSVP we will need you to fill out the online survey @, www.surveymonkey.com/s/OpenhouseReunion.

Martin Anselm, Manager AREA Consortium

NEW REPORTS @ http://www.uic-apl.com/reports/2013-reports

"Board-Level Drop Test: Comparison of Two ANSYS Modeling Approaches and Correlation with Testing"

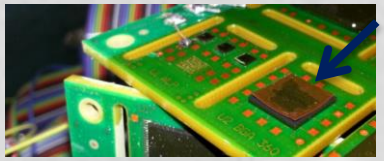
"Effect of Sn Grain Morphology on Failure Mechanism and Reliability of Lead-Free Solder Joints in Thermal Cycling Tests"

"Effect of Variation in the Reflow Profiles of Pb Free Solder on Lifetimes in Room Temperature Fatigue Tests"

"The Evaluation of Dip Solder Paste for the Assembly of Through-Molded Via (TMV) Package on Package (PoP)"

MAT8A: Conformal Coating

All boards are in -40C to 125C thermal cycling and have completed approximately 150 cycles. We plan on presenting some of the early characterization work and process details at the September meeting. Thus far only some component delamination was observed on a urethane material. We hope to have some failures to report before the meeting.



MAT2B: Effect of Aging on Reliability of Packages in Thermal Cycling Test

We are examining the effect of isothermal pre-aging on the reliability of solder joints in thermal cycling test. Homemade components with 10 and 16 mil solder spheres are prepared. Boards were isothermally pre- aged at 125°C for various times and then subjected to thermal shock test. Careful precipitate measurement is in progress to evaluate the effect of pre-aging on recrystallization and failure mechanism of joints. Results will be presented during the Sept. meeting.

REL4A: Creep Corrosion

Two sets of experiments are currently underway in FoS chambers, both involving all 6 surface finishes of TB2013. In the first the samples are intentionally contaminated with two fluxes, one a low-activity halide-free and the other an active flux containing chloride. The second experiment uses a saturated potassium chloride solution to control the humidity inside the chamber instead of the "standard" potassium nitrate. The relative humidity at 60°C is almost the same for both solutions, but there are some reports that the creep corrosion rate in the KCl case is higher, presumably because of the presence of chloride ions in the system. The aim of the test is to verify this claim.

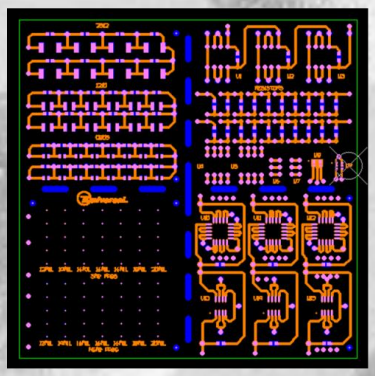
advanced process lab

AREA Consortium

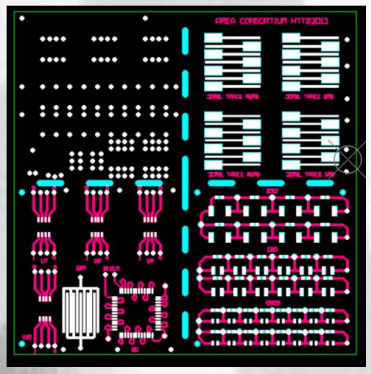
MAT6B: HMP Materials and Manufacturing

We finished designing a high temperature polyimide test board for down-hole, and high temperature automotive and aviation applications. The design was submitted to the board company and the board is expected to be delivered by the end of September. A Gerber image of the board is shown below. We will study process, materials, and reliability of high temperature electronics. A detailed explanation of the planned studies will be provided at the September meeting. If you are interested in participating in this project please contact Harry Schoeller (Harry.Schoeller@uic.com) or Martin Anselm (Anselm@uic.com).

Front



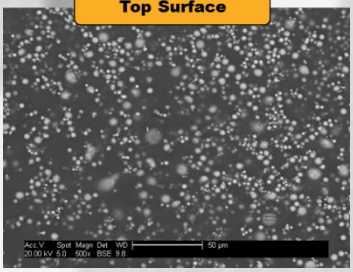
Back



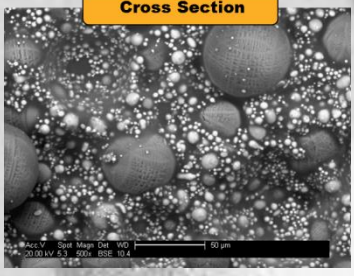
MAT4A: TIM, Component Level Gap-Pad Characterization

In August we finished thermal storage testing of six select gap pads. Samples were compressed to 30% and aged for 1000hours at 125°C. A total of 11 fixtures were built to complete this portion of the study. An image of the fixtures in the chamber is shown right. Additionally the cross sections of each gap pad were imaged using SEM then analyzed. A significant difference was observed between the top surface and cross section microstructure. Example images are shown below. The results of this testing will be presented at the September meeting.

Top Surface



Cross Section



Board Designs

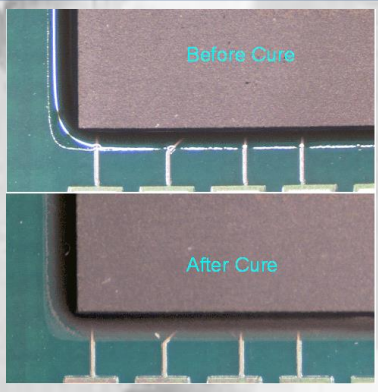
We have been actively designing new test boards for various projects. Currently, we are procuring a new drop test board designed with symmetry intended to reduce sample sizes and test time when compared to the old JESD22-B111 drop test design. We are also acquiring boards for conformal coat and underfill studies using SnPb assemblies and we are working on a simple design for our continuing efforts with Binghamton University's vibration test program.

MAT7A: New Alloy Research

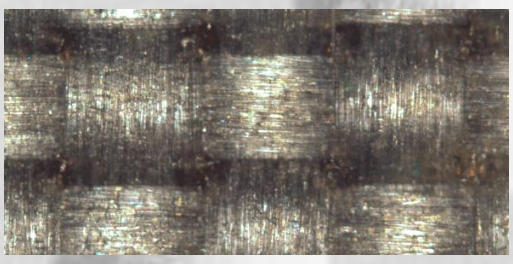
Our room temperature shear fatigue of various solder alloys test shows some interesting results. Clearly lifetimes of various solder/Cu joints in room temperature fatigue tests showed distinct dependences of lifetime on solder composition, as well as on the reflow profile used to produce the solder joints, in particular cooling rate and duration. Distinct increases in lifetimes with increases in Ag content were observed in SAC/Cu solder joints and with increases in cooling rate from the melt during reflow. Thus it was shown that room temperature fatigue tests display promise as a relatively simple and sensitive means to monitor the effect of different parameters. The reliability testing on these alloys will start soon. Five different alloys (SAC 305, SnPb, SN100C, SN99CN and SAC-Mn) at four different sizes were provided by our members. Homemade components for 300 boards (three different pad finishes) are being built. ATC testing on these boards will start soon. Preliminary results will be presented during the Sept. meeting.

MAT1A: Underfill Studies

Two materials have been acquired and a third is expected soon. The first material is already being used with the side coupon of TB2013 in flow rate studies and in trial runs to establish the dispense parameters that lead to uniform fillets. The boards for the thermal cycling performance evaluation of this underfill have been assembled and are waiting to be underfilled.



MAT10A: Laminate and Glass Studies in Pad Cratering



Hot Bump Pull strength measurements of PCBs with the same type of resins and identical pad design but from a new source are being taken, to investigate the difference between nominally similar substrates. Differences in strength were seen, which could at least partially be connected to differences in the glass weave. The analysis of the effect on strength of the pad location relative to the underlying glass bundles is continuing.

ADP3A: TB2013

Our TB2013 assemblies, designed to evaluate the effect of board finish on surface mount reliability, have surpassed 1,700 -40 to 125ºC thermal cycles. Not surprisingly, the results are complicated with some devices performing better on certain finishes than others. Many of the failed devices have been removed from the test chamber and are being subjected to failure analysis.

REL2A: Lead-Free Solder Fatigue Phenomenological Models

Acceleration Factors for Thermal Cycling of SnAgCu:

We have shown the acceleration factors for SAC305 joints in thermal cycling to vary strongly with solder joint dimensions. In the absence of interlaced twinning smaller solder volumes and pad sizes tended to give stronger acceleration. This is consistent with our new thermal cycling model: We find a clear correlation between the acceleration factor and the initial spacing of the secondary precipitates. This spacing tends to vary systematically with solder volume and pad size because of differences in undercooling after reflow.

However, small solder joints often have an interlaced Sn grain structure, if the undercooling is strong enough, in which case the acceleration factor is not as high. Sensitivity to impurities and possibly other factors make it impossible to fully control or predict this under realistic manufacturing relevant conditions.

We conclude that the observed trend is likely to be general for area array solder joints in the absence of interlaced twinning.

Life of Lead Free Solder Joints in Isothermal Cycling with Varying Amplitude:

Even if we are not concerned with the actual life of our assembly in service, but just comparing to different designs or materials in routine 'engineering' tests, our real concern is still performance under realistic service conditions. These conditions invariably involve significant and ongoing variations in 'cycling' amplitudes. This may be important because variations may shorten life strongly compared to estimates based on common damage accumulation rules. Common accelerated tests with fixed amplitudes do not provide any idea of the magnitude of such effects, and random vibration testing offers at best a single point assessment which may be extremely far from the worst that can happen.

Even relative comparisons may require us to account for effects of the specific loading history on the solder properties, and thus on pad cratering and intermetallic failure as well as on solder fatigue. This is so among other because different solder alloys are more or less sensitive to variations. We have now shown high-Ag alloys to be more sensitive than SnAgCu alloys with less Ag. Notably, SnPb behaves somewhat differently. Preliminary indications are that this alloy is less sensitive to a few variations, but life under ongoing variations such as might be expected in long term service may be reduced by much more than for SAC305.