

Dear Members,

The 2015 mid-year AREA Research Reports are nearing completion. Consortium research topics have been grouped into four topical sessions for these web based reviews: Laminate Materials, Solder Paste Printing, Solder Interconnects, and Die Attach Materials. If you missed any, or would simply like a content refresh, all presentation material will be archived at [uic-apl@uic.com](mailto:uic-apl@uic.com) under 2015 Meetings.

We have several new project starts planned in the coming months:

- MAT6E. .. Passive Device .. Thermomechanical Reliability in High Temperature Applications
- MAT6F. Evaluation of Pb-free Alloys for Engine Control Applications
- REL3A. Compliant Pin Connections
- REL15A. Power Cycle Reliability
- APD1A. Broadband Printing (see below)

These projects are being actively defined now—test vehicles, experimental design, procedures, etc. If any pique your interest, please reach out and let us know. Your input in the planning phase always improves our research.

Sincerely,

Jim Wilcox  
Consortium Manager

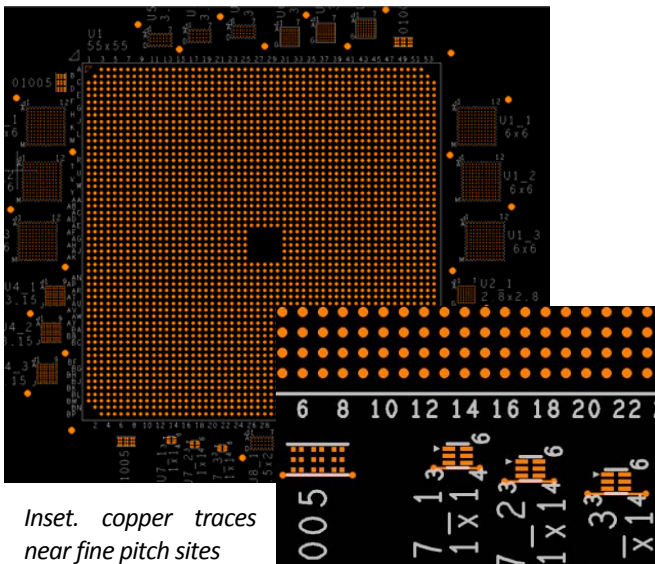
### APD1A. Broadband Solder Paste Printing

The need to print fine paste features in close proximity to the large paste deposits used with more massive SMT components is a recurring challenge for complex board assembly. A test board is being sourced for such broadband solder paste printing experiments. This test board places numerous chip scale wafer level packages, QFNs (0.35 and 0.5 mm pitch) and small form factor passives (01005) around the perimeter of

55x55mm BGA (1.0 mm pitch) sites.

A paste printing evaluation matrix using various stencil attributes is planned. Varying stencil step heights will be evaluated on different stencil technologies (included nanocoatings).

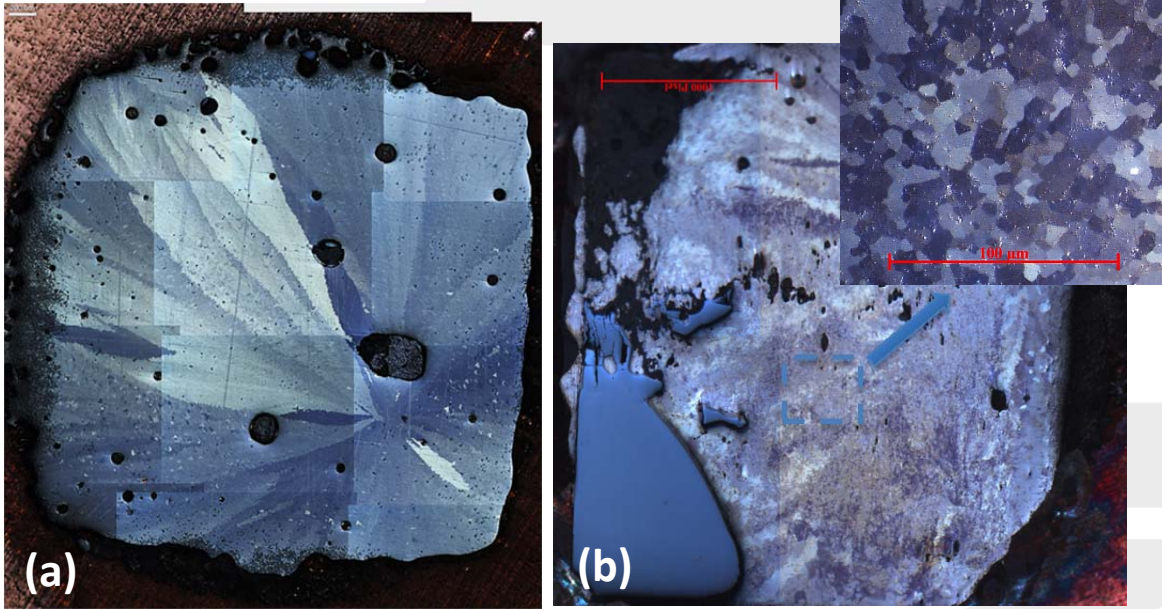
Components will be assembled to the A side of the board using the best printing parameters identified. The B side of the board includes additional complicating design features such as copper surface trace topography and will be used for paste printing experiments only.



*Inset. copper traces near fine pitch sites*

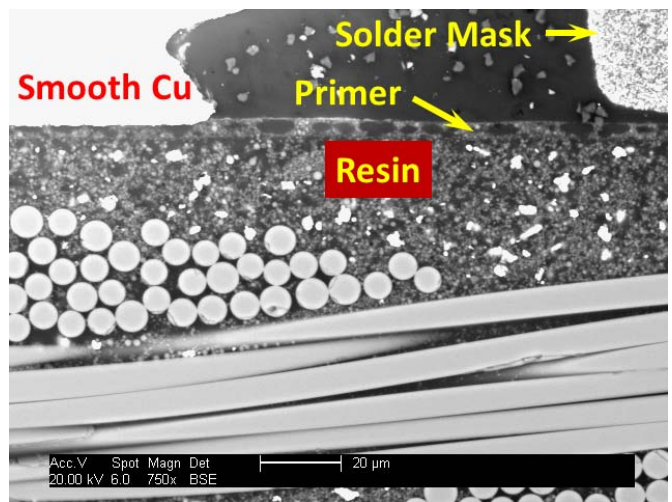
## MAT6H. Evaluation of Bi-Based Die Attach Materials

An update on our Bi-based solder die attach evaluation is being webcast July 2, 2015. This update examines the brittle to ductile transition in BiAgX™, a commercially available Bi-based solder. Image (a) below shows a z-section of the coarse grain structure found in as-reflowed BiAgX™. At elevated temperatures, if the applied stress exceeds the recrystallization threshold stress, the grain structure radically transforms into a fine grain structure. A z-section image of the microstructure after recrystallization is shown in figure (b). This microstructural transformation is accompanied by a fourfold increase in the total shear deformation before fracture. Contact [Harry.Schoeller@uic.com](mailto:Harry.Schoeller@uic.com) with your questions and comments.



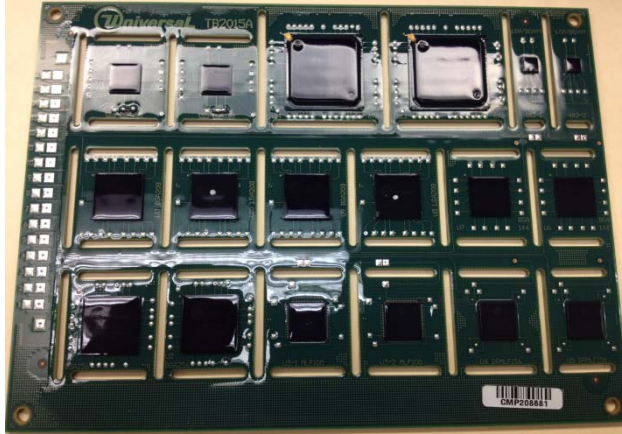
## MAT2D. Effect of Cu Roughness on Pad Strength

Coupons made with the second smoothest Cu foil were available with and without primer. Testing these coupons allowed decoupling of the contributions of primer and of Cu roughness on pad strength. In prior testing of the smoothest and roughest Cu foils, the samples differed both in roughness and primer status, confounding these two effects. Cross-sections showed that the primer layer of the second smoothest group was very different from the primer layer of the smoothest, which should affect the magnitude of its impact on pad strength. To evaluate strain rate effects on pad strength, additional tests were conducted at different pull speeds.



### MAT8B. Conformal Coating Materials

Humiseal UV40 and U50 polyurethane coatings have been applied to TB2015 boards assembled on either front side or back side. These coated boards are being prepared for thermal cycle reliability testing. Additional coating materials are planned, including several new plasma deposition nanocoating materials.

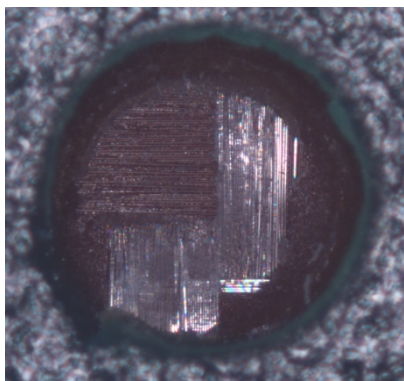


TB2015 Side A assembly; UV50 coated.

In a related side project, the TB2013 resistor array site has been populated with standard SMT resistors (*i.e.*, without anti-sulfur finish). These coupons will be used to compare the corrosion resistance imparted by various conformal coating materials. Coatings include polyurethanes (Humiseal U40, UV50 and, ELPEGUARD SL 1301 ECO-FLZ) acrylics (Humiseal 1B73) as well as two Semblant PlasmaShield nanocoatings. All will be tested for creep corrosion in a flowers-of-sulfur chamber.

### MAT2C. High Tg PCB Laminate Materials

The pad cratering propensity of ten high Tg laminates ( $T_g > 180^\circ\text{C}$ ) are being compared using the solder bump pull method. Laminates have been provided with high and low resin stackups for each material. The first leg of the project, with 24 pads pulled for each laminate, resin content, and reflow precondition combination, is complete. Pad strength



Failure at glass cloth interface.

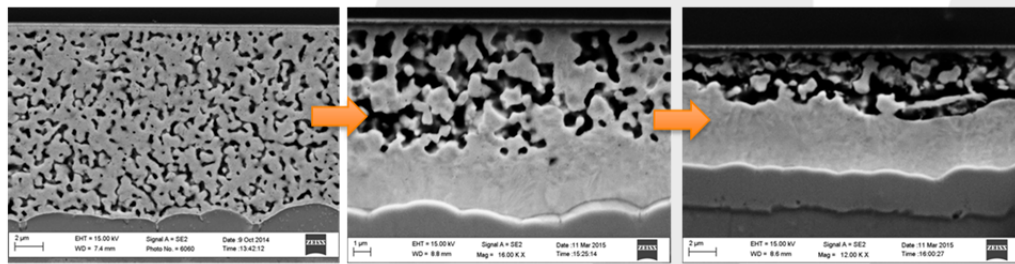
results over the range of tested laminates varied by nearly a factor of two. Analysis of the results is ongoing. In addition to statistical comparisons among the strength data sets, the analysis includes detailed examination of all failure surfaces for changes in dominant failure mode. Cross-sections of boards with different laminates and resin content are also being examined.

Laminate Materials
Shengyi S1000-2M
Taiwan Union Tech Corp TU-865
Hitachi MCL-HE-679G(S)
Elite Material Co EM-888S
Shengyi S7439
Shengyi S7338
Hitachi LW-900G
Panasonic Megtron-7 NE glass
ITEQ IT-968
Doosan DS-7409D(VN)

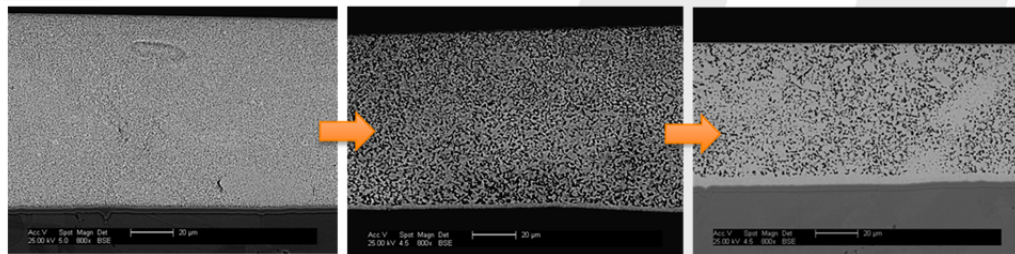
## MAT6B. Sintered Silver Die Attach

An update on our sintered-Ag die attach evaluation is being webcast on July 2, 2015. This update examines the effect of sintered-Ag bondline thickness on high temperature performance and thermal cycling reliability. The desire for increased thermal dissipation in high power applications often drives thinner die attach bondlines. The morphological stability of sintered-Ag attachments has been found to depend substantially on this bondline thickness. The images below show the evolution of thin and thick sintered-Ag bondline structures through high temperature storage.

### THIN BONDLINE



### THICK BONDLINE



We are now in the planning stage for new development studies on the sintered-Ag die attach process (time, temperature, thickness, pressure). If you would like to get involved with the planning for this latest study or have questions on our current work contact [Harry.Schoeller@uic.com](mailto:Harry.Schoeller@uic.com).

## MAT1B. Reworkable Component Underfills

Assemblies underfilled with the latest reworkable encapsulant (material F) were submitted for ATC testing. Two additional underfill materials have been received and are now undergoing flow tests for underfill rate and voiding levels.

TB2015U, the new test board that will be used for the evaluation of SnPb eutectic solder assemblies, has been designed and ordered. Half of the TB2015U SnPb assemblies will be washed to remove the no-clean flux residues prior to underfilling. The other half will be underfilled without washing. The thermal cycle reliability of the two sets of underfilled assemblies will be compared.