
Reworkability of Underfill Materials

NEPP Deliverable

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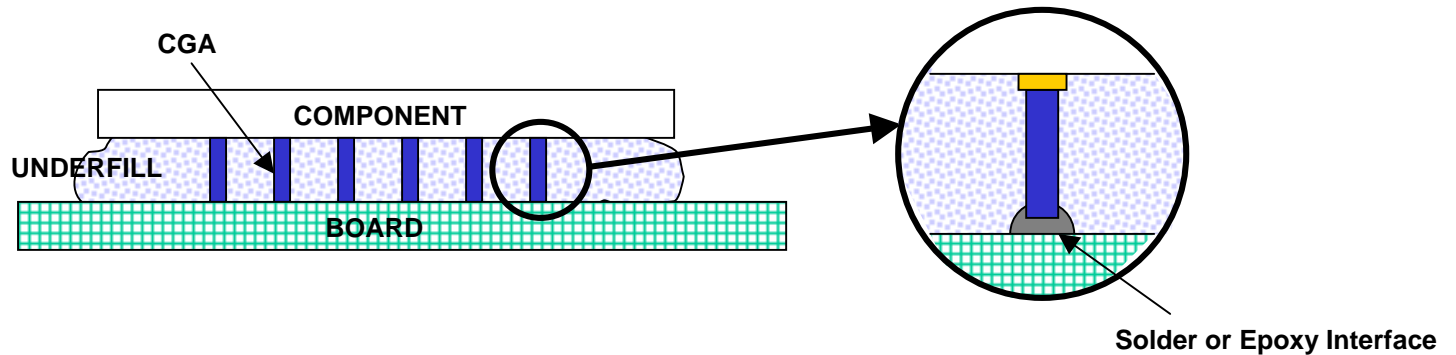
10/10/01

Outline

- Objective
- Procurement
 - underfill material, and two rigid boards (one with pins, and one without pins)
- Assembly Process
 - Mate two rigid boards using conductive epoxy
 - Column Grid Array (CGA) interconnection
 - Fill with underfill around CGA interface
- Test Plan
 - temperature cycles
 - Destructive Physical Analysis (DPA)
- Removal Method Experiment

Objective of the Evaluation

Task: Underfill evaluation to improved the reliability of the interconnect using Column Grid Array (CGA) attachment between the board and the components. Evaluate reworkability of underfill materials.



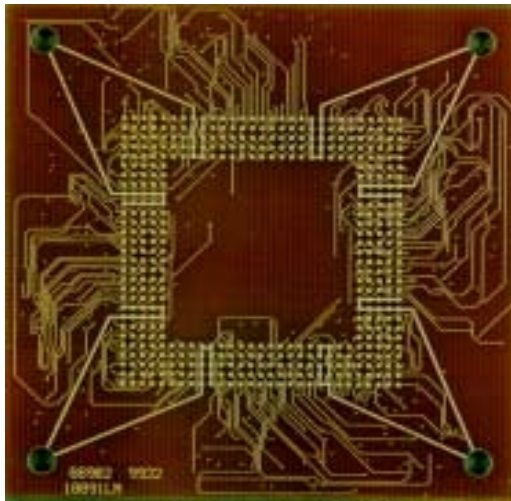
Benefit:

- determines the suitable underfill for space application with CGA
- compromise the CTE mismatch between the board and the component
- saving boards by reworking underfill

Two Rigid Boards

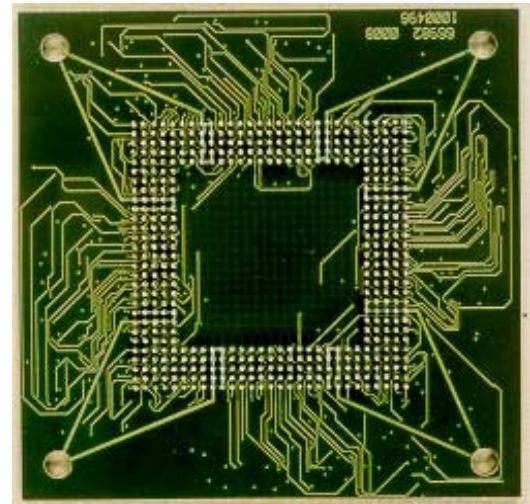
- Rigid Board 1

- Polyimide substrate without CGA
 - top: compliance connector pads
 - bottom: BGA pads



- Rigid Board 2

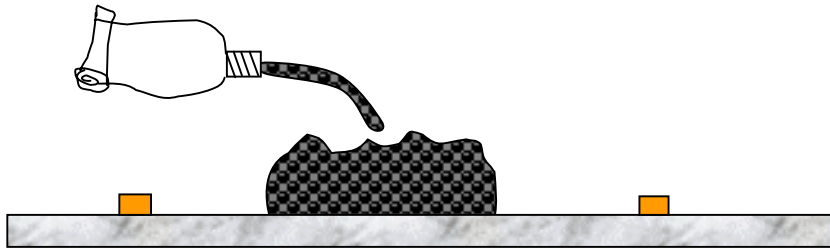
- Polyimide substrate with CGA
 - top: compliance connector pads
 - bottom: CGA pins



Procured Underfill Materials

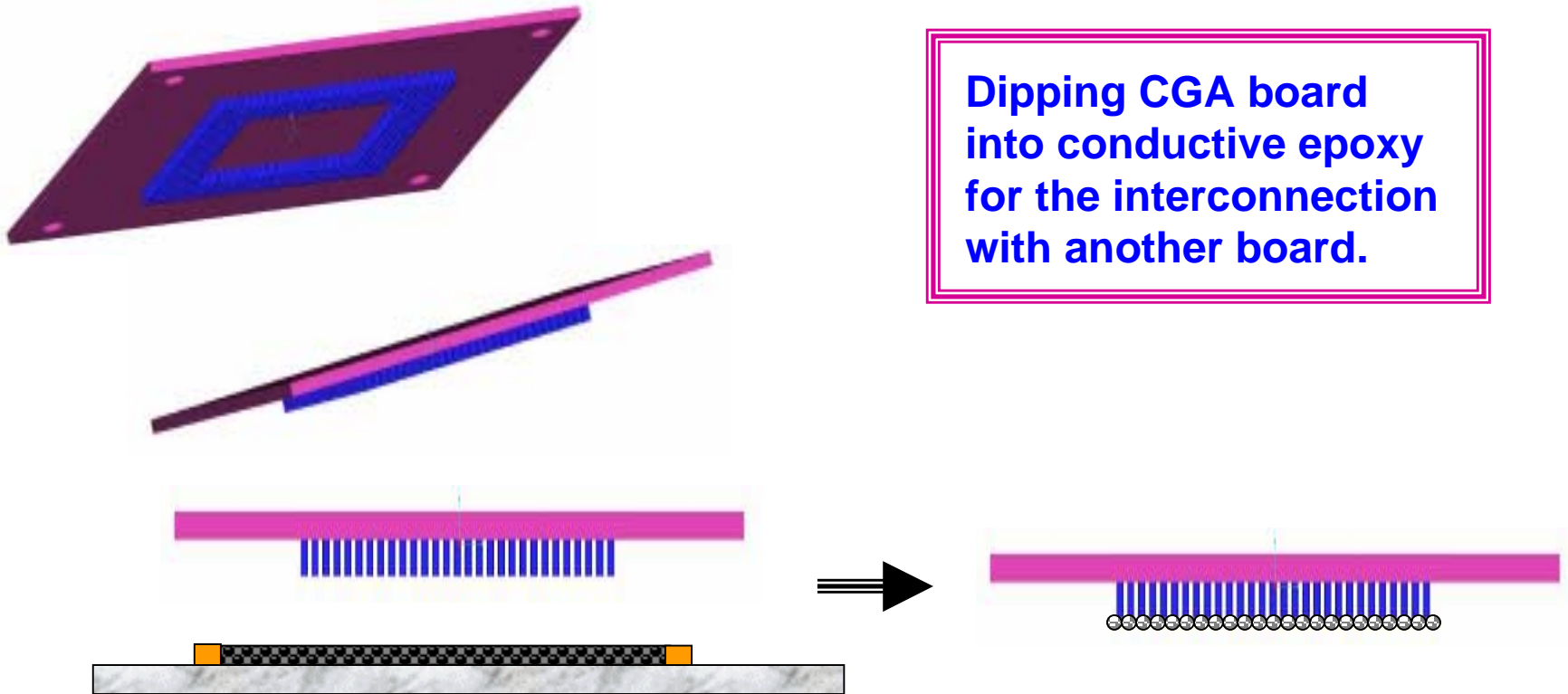
- Underfill Candidates
 - Thermoset: ME526 (Red)
 - Loctite: 3567 (Cream)
 - Dexter: FP 4511 (Black)
- Dissipation Method
 - Using Syringe, underfill was applied around the edge of the board
- Outgassing Test
 - All materials are subjected to outgassing test

Assembly Process



- Lay 5 mil thick Kapton tape on a glass plate to use as a dam.
- Squeeze conductive epoxy to fill the dam.
- Even out the epoxy. Remove excess.
- Ready for dipping. Gives a known thickness.

Assembly Process



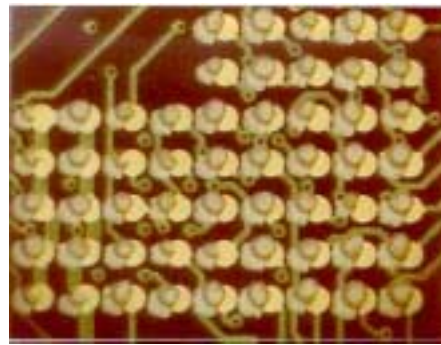
**Dipping CGA board
into conductive epoxy
for the interconnection
with another board.**

Initial Evaluation

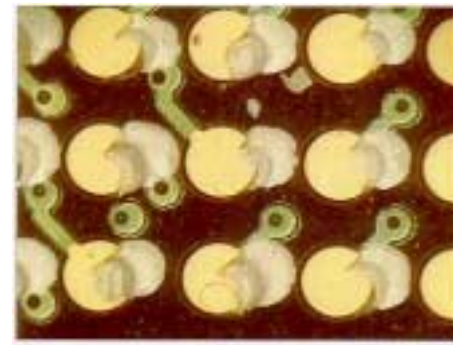
- Five (5) assemblies were subjected to electrical continuity test before the underfill was applied: All passed
- Alignment of the CGA on the pads (the worst case)



Epoxy on CGA tip



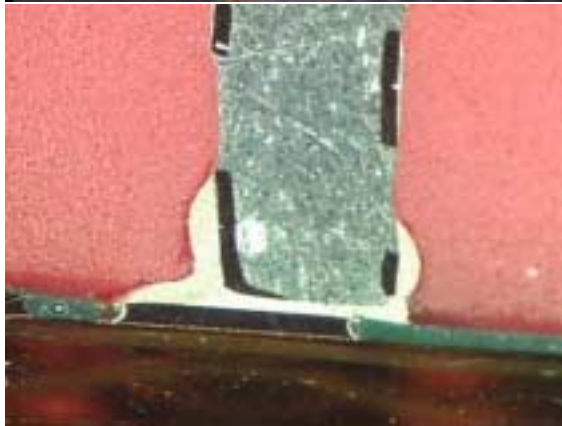
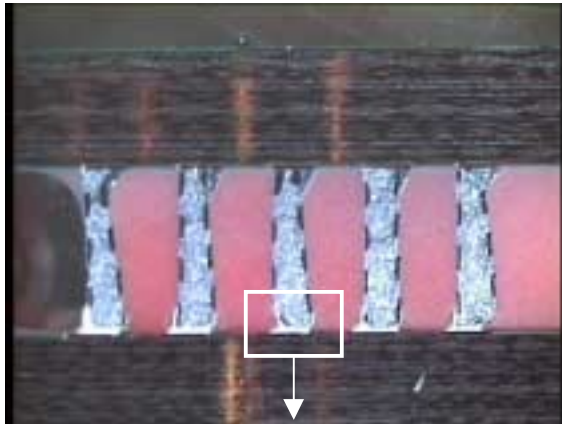
**Epoxy residue on
the BGA pads**



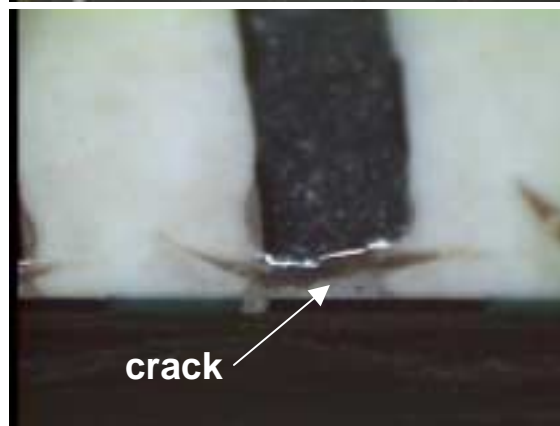
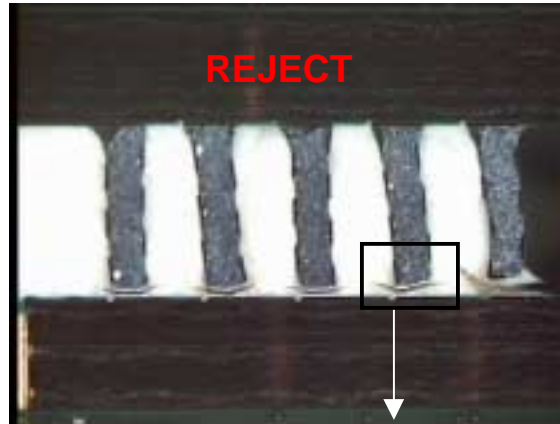
**Close up: Epoxy
residue on
the BGA pads**

Cross-section before Temperature Cycling

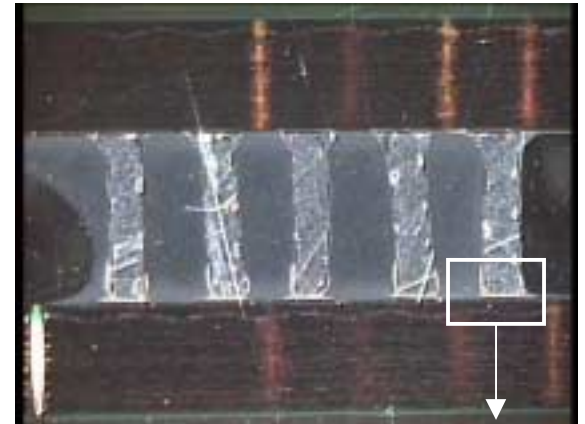
ME562



LOCTITE 3567

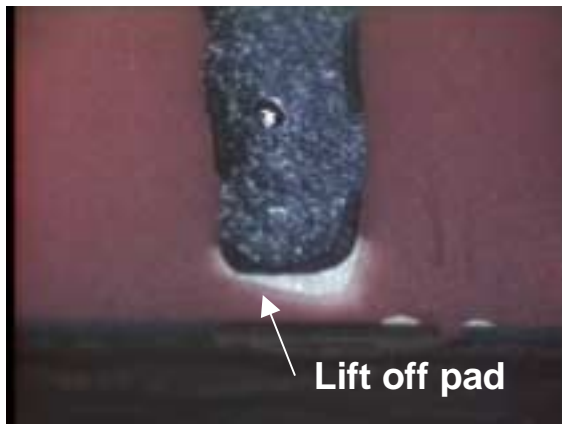
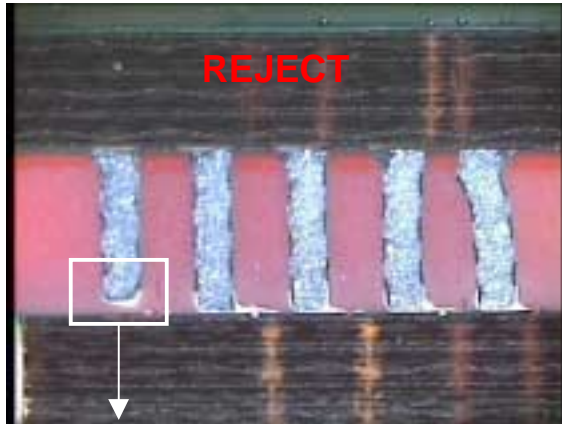


FP-4511

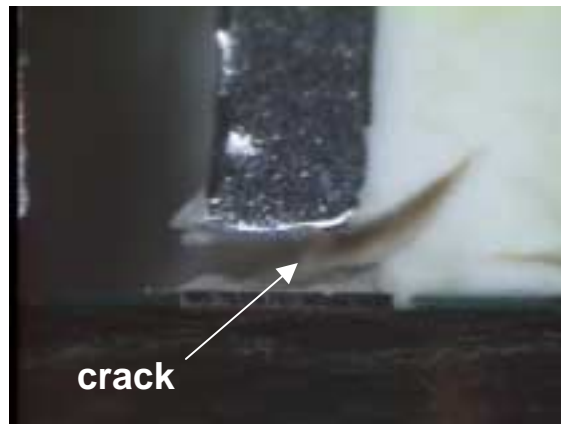
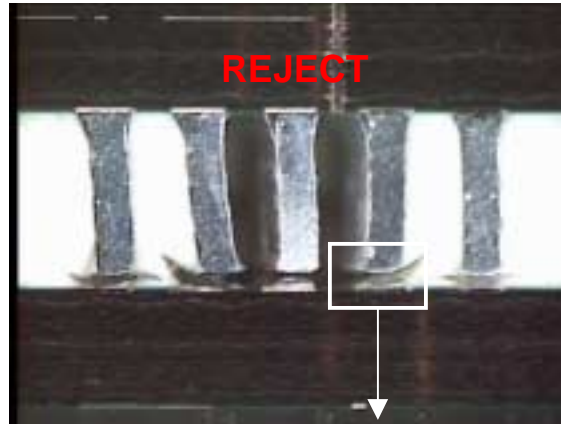


Cross-section after Temperature Cycling

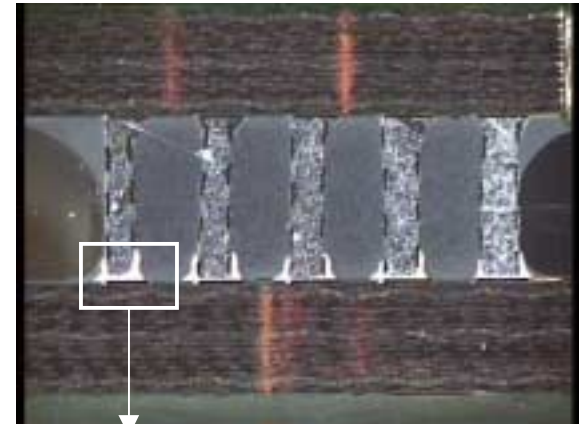
ME562



LOCTITE 3567



FP-4511

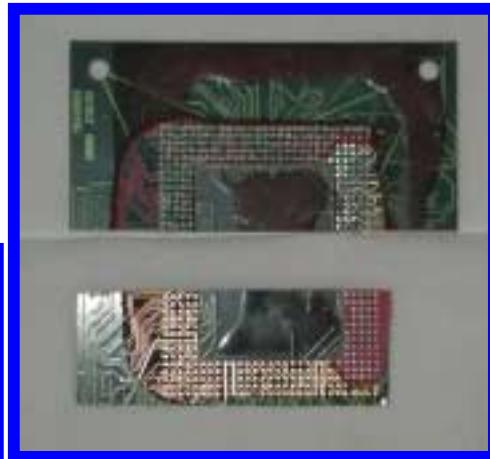
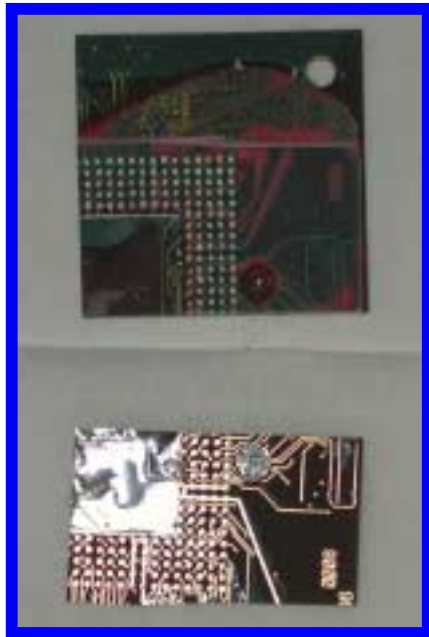


Proposed Method of Rework

- Heat Applied Method
 - Heat the hot plate and up to 230 C (recommend localize heating).
 - Place the sample and heat it up for 30 seconds (~200 C).
 - Using the pliers, give a small twist to separate two substrates.
 - Remove them from the heat and turn the hot plate off.
 - The entire process shall not be taken no longer than 2 minutes.



Results: ME526



**Before
Temperature Cycled**



**After
Temperature Cycled**



Results: Locktite 3567



**Before
Temperature Cycled**

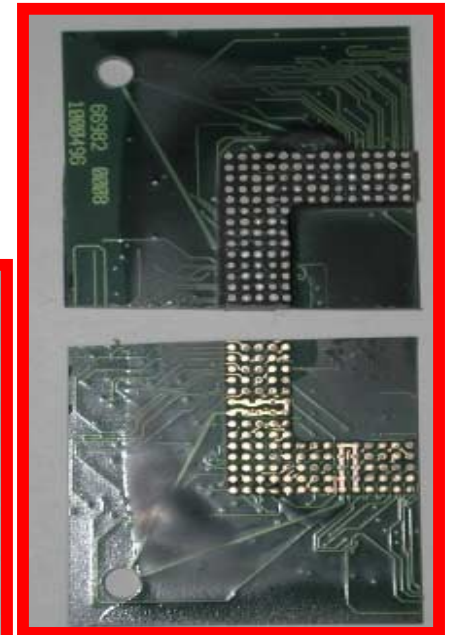
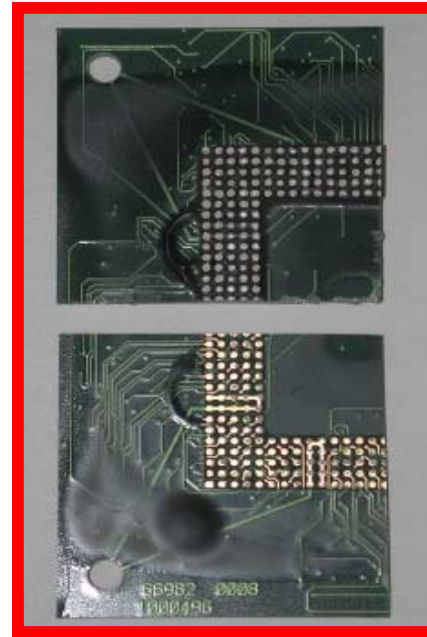


**After
Temperature Cycled**

Results: FP-4511



Before
Temperature Cycled



After
Temperature Cycled

Cleaning Method

- Tool Used: Dremel 2 Variable Speed
- Brush: Black Flat Synthetic material
- Temp: Ambient Temperature
- Speed: #2; approximately 15,000 rpm
- Instructions:
 - Place the brush equipped Dremel tool on the substrate where the adhesive residue to be removed.
 - Gently press the brush during cleaning.

Conclusion

	Characteristics		
	Color	Viscosity (cps)	Tg (°C)
ME526	RED	2,500	155
Loctite 3567	CREAM	~10,000	94
FP-4511	BLACK	8,500	150
	Qualification Tests		
	Outgassing	Reworkability	Cleaning
ME526	FAILED	MODERATE	VERY DIFFICULT
Loctite 3567	FAILED	EASY	EASY
FP-4511	PASSED	MODERATE	DIFFICULT