Reliability studies of anisotropically conductive adhesive joined flip chip components with conformal coatings

Dr. Tech. Kati Kokko
Department of Electronics
Tampere University of Technology
Finland
Outline

• Our test setup
• Flip chip technology
• Coating materials and structures
• Reliability testing
• Results and discussion
Our test setup

- FR-4 substrate with anisotropically conductive film (ACF) joined flip chip
- Polyimide substrate with ACF joined flip chip
- Protective coating
  - Epoxy
  - Parylene C
  - Epoxy-Parylene C
- Reliability testing
  - 8585 –testing
  - -40/+85 thermal cycling
- Failure analysis
Flip chip technology

- Flip chip joining is made face down
- Solder joining
- Adhesive joining
  - NCA (non-conductive adhesives)
  - ICA (isotropically conductive adhesives)
  - ACA (anisotropically conductive adhesives)
ACF joining of flip chips

a) ACF

b) Light pressure and low temperature

b) Substrate

c) Chip Bump Pad

d) Bonding pressure and temperature

Coating materials used

- Epoxy

- Parylene C

- Epoxy – Parylene C sandwich
Test chip structure

- Test chips used in the studies were specially designed for testing
- Daisy chain resistance was measured during testing
- Real time measurements were used to better detect the behaviour of the samples during testing
Reliability testing

- 85/85 –testing
  - 85 % relative humidity
  - 85 °C
- One test period 500h
- Total duration 7,000h

Liu, Salmela, Särkkä, Morris, Tegehall, Anderson: Reliability in Microtechnology: Interconnect, Devices and Systems

- Flip chips on FR-4
- Test lots
  - without coating
  - Epoxy coating
  - Parylene C coating
  - Epoxy – parylene C sandwich
Reliability testing

- Thermal cycling test
  - -40/+85 °C
  - Duration of a cycle 30min
  - Test lasted 6,000 cycles

- Flip chips on FR-4 and polyimide substrates
- Half of the test lots were coated with parylene C
Reliability results from 8585 testing

Reliability of coated samples

- Non Coated
- Epoxy
- Epoxy + Parylene C
- Parylene C

Hours tested

Failure %

0 1000 2000 3000 4000 5000 6000 7000
Reliability results from -40/+85 cycling

• Test lots with polyimide substrate did not have any failures during 6,000 cycles
Daisy chain resistance measurements

![Graph showing voltage and temperature against each other. The blue line represents voltage and the red line represents temperature.](image)
Daisy chain resistance measurements
Daisy chain resistance measurements
Failure analysis, 8585 test

A sample from non-coated test lot

A sample from Parylene C coated test lot
Failure analysis, -40/+85 cycling

A sample from non-coated test lot

A sample from Parylene C coated test lot
-40/+85 cycling, Polyimide substrate
Conclusion

• Reliability studies in 8585 constant humidity test and -40/+85 thermal cycling test were conducted
• The test specimen had ACF joined flip chips on FR-4 and PI substrates
• Epoxy, Parylene C and Epoxy-Parylene C sandwich structures were studied as protective coatings
• Reliability results show long durability against humid environments and thermal cycling
• Parylene C proved to be the best alternative for protective coating from the tested materials in humid environments
• In thermal cycling the protective coating did not have much effect to the reliability
• Failure analysis showed delamination as the main cause for failures
THANK YOU!

Further information: kati.kokko@tut.fi