Testing the Reliability of Solder Balls

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Overview

Problems and Solutions

The Experiment

- Materials
- Methods

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Conclusion

More Storage with Less Packaging

Problem

- Dual in-line packages (DIPs) are packages being used for memory and they are changing to denser packaging
- Connecting components to printed circuit boards (PCBs) requires the lead of components being embedded into drilled holes in PCBs
- It is not efficient to drill hundreds of holes through PCBs for denser packages

Solution

- Using smaller pads with solder paste or solder balls to make connections to the board or PCBs
- Smaller and thinner packaging size, with more output and input channels from a single die, are in high demand

The Experiment

Materials

Solder Balls and Chips

- SAC105 NiAu
- SAC305 NiAu
- SA105 OSP

Machines

- Nordson Dage 4000 Plus
- Duster
- Dage Shear 187-0307915163
- Hakko 394

*SAC105 contains 98.5% Tin (Sn), 1.0% Silver (Ag), and 0.5% Copper (Cu). SAC305 contains 96.5% Sn, 3.0% Ag, and 0.5% Cu

Methods

1. Turning the vacuum and Dage machine on
2. Changing the calibrations using the computer to adjust speeds
3. Performing shear tests
4. Collecting data and plotting it on a graph

Fig. 1(a) Hakko 394 is used to pick up the microchip from suction

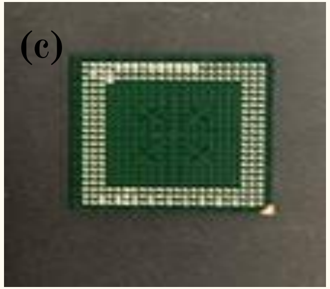

Fig. 1(c) A 0hr SAC105 NiAu chip post shearing

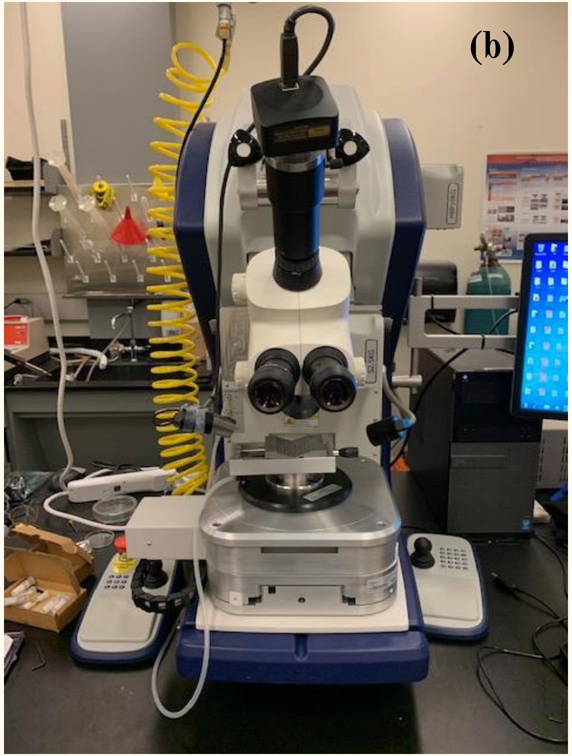

Fig. 1(b) The Nordson Dage 4000 plus is used to perform shear tests

Data

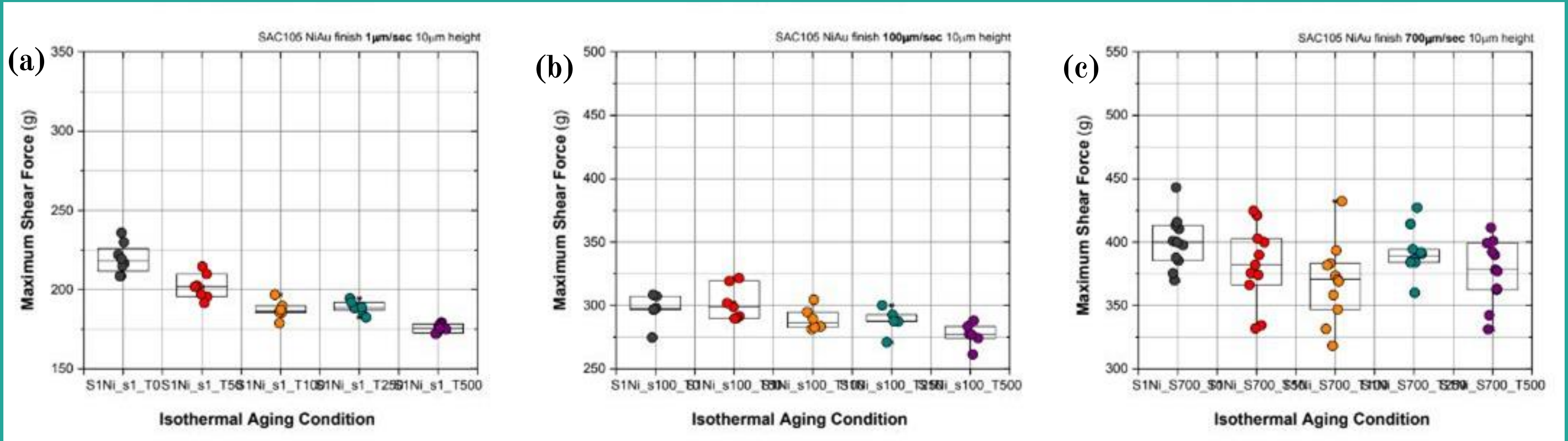

Fig. 2(a) The SAC105 NiAu surface shear test results with 1μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

Fig. 2(b) The SAC105 NiAu surface shear test results with 100μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

Fig. 2(c) The SAC105 NiAu surface shear test results with 700μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

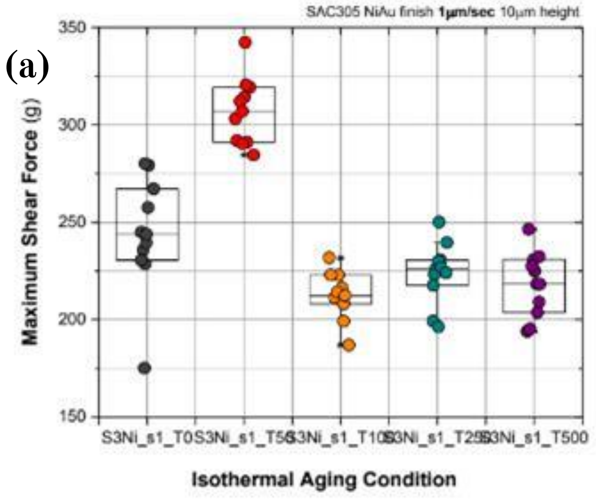

Fig. 3(a) SAC305 NiAu surface shear test results with 1μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

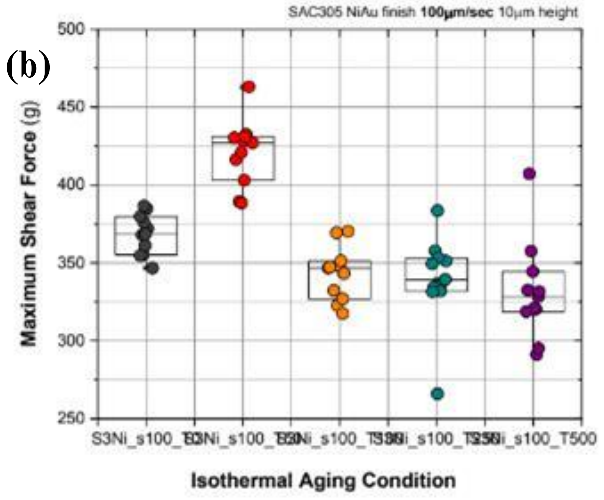

Fig. 3(b) SAC305 NiAu surface shear test results with 100μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

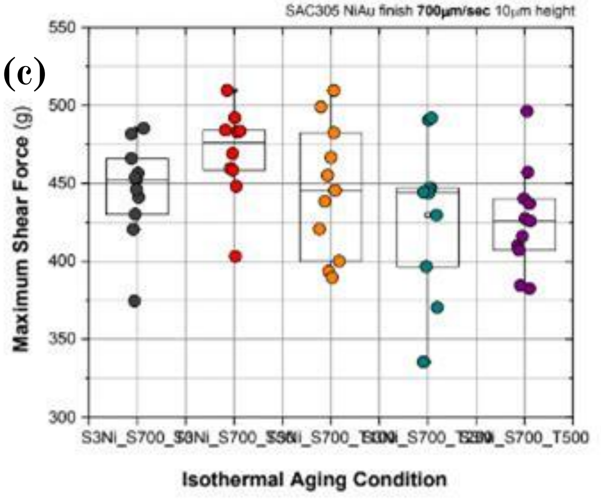

Fig. 3(c) SAC305 NiAu surface shear test results with 700μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 250hr, and 500hr.

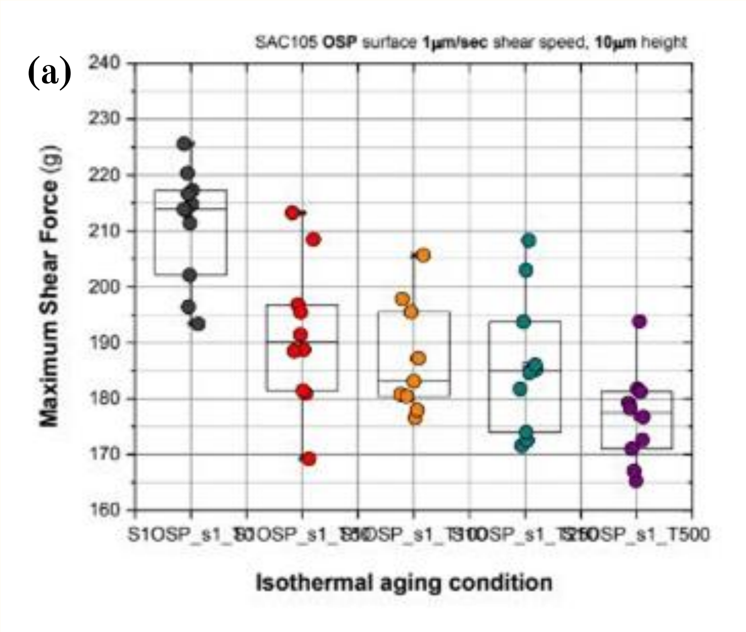

Fig. 4(a) SAC105 OSP surface shear test results with 1μm/s shear speed and 10μm shear height at isothermal aging conditions 0hr, 50hr, 100hr, 100hr, 250hr, and 500hr.

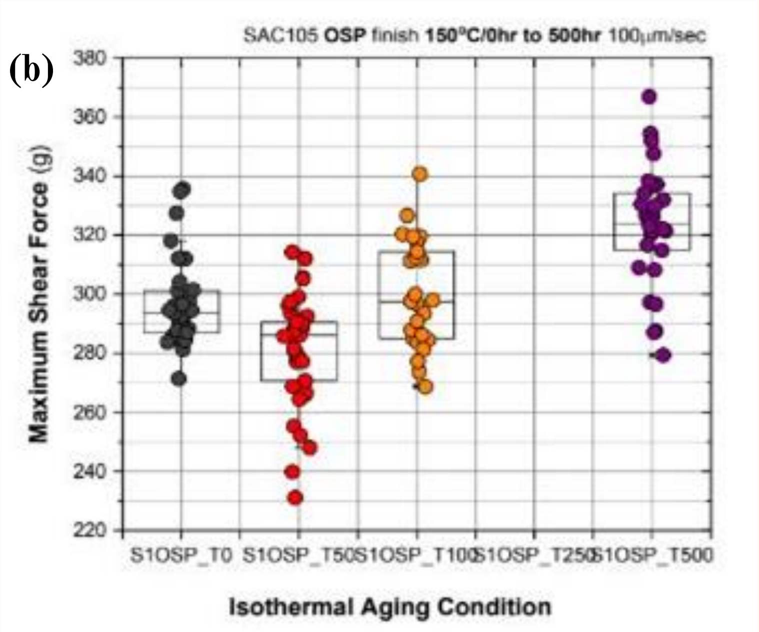

Fig. 4(b) SAC105 OSP 100μm/s shear test results at isothermal aging conditions 0hr, 50hr, 100h and 500hr.

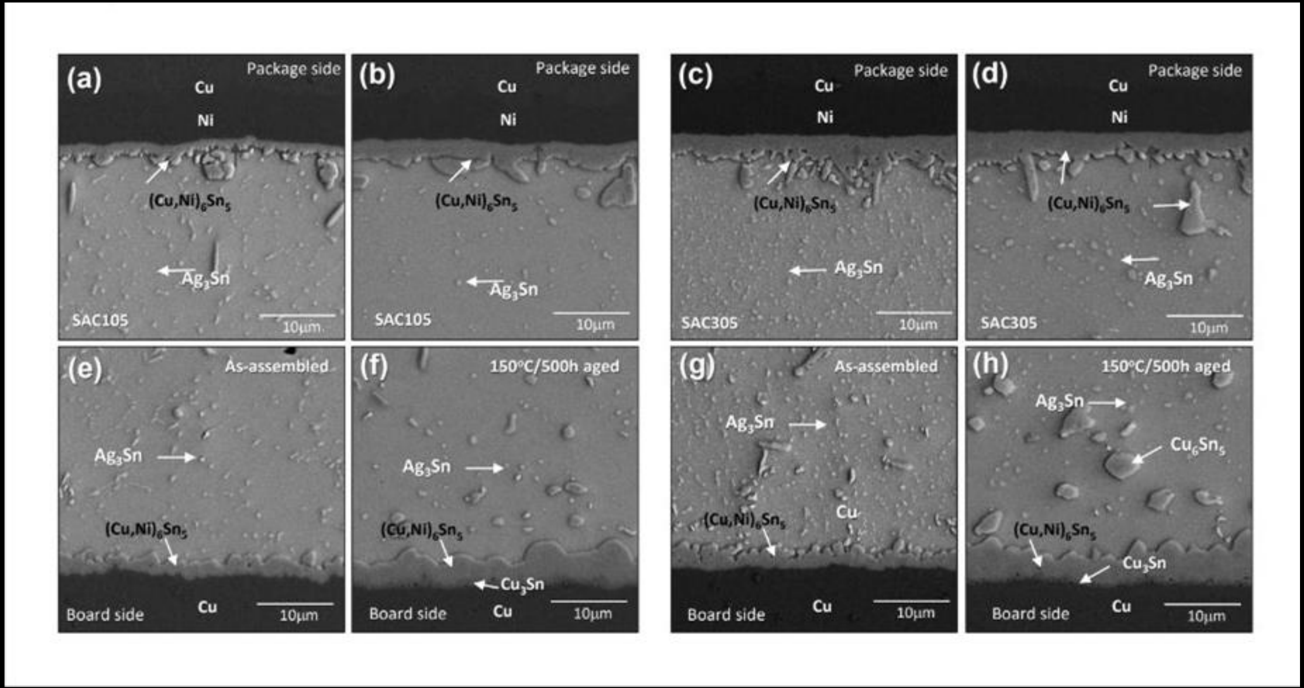

Fig. 5 Scanning electron microscopy cross-section microstructure of SAC105 (a)(e) before aging and (d)(f) after aging at 150ºC/500h. SAC305 before aging (c)(g) and after aging at 150ºC/500h (d)(h).ºC/500h.

Conclusions

- It is recognized that the 700µm/s test results, in figure 5, do not demonstrate a wide range of distinguishable data. At each aging condition, the average shear forces are close to one another. It would be better to use the 100µm/s shear test because it gives the best data.

- The average strength of SAC305 NiAu at 500hr aging does not get lower than the average strength of SAC105 NiAu but it does get lower than that of SAC105 OSP.

- The OSP chips have a higher tensile strength, which makes them stronger; however, this means they are also more brittle so if there is a sudden drop they are more likely to break. The SAC105 at a lower age have a lower tensile strength compared to the OSP chips, but they will not break as easily after a sudden drop.

Acknowledgments

This research was funded by:

- National Science Foundation (NSF)
- The Garden State Louis Stokes Alliance for Minority Participation (GS-LSAMP) at Rutgers University

Thank you to:

- Dr. Jiao
- Dr. Lee
- Siri Vegulla
- Portland State University
- Rutgers University

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