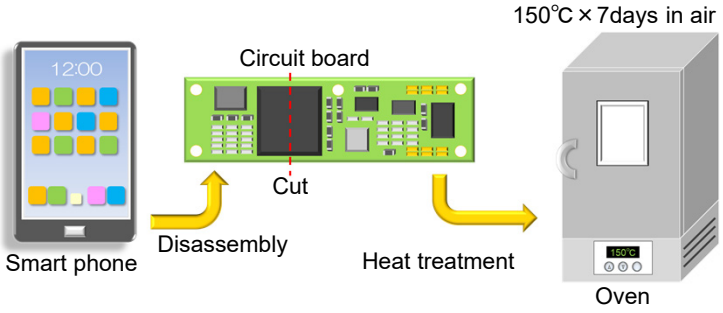
Measurement of thermal and mechanical properties in micro areas for circuit board

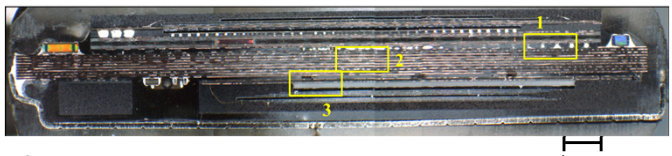
In the circuit boards of highly integrated electronic devices, the evaluation area is becoming smaller and smaller. The use of a microprobe-based physical property evaluation method enables measurement with micron- to nanoscale resolution. A case study will be presented in which a heat load test was performed on a circuit board and changes in physical properties before and after the test were measured from the cross section of the board.

Measurement object and heat load test

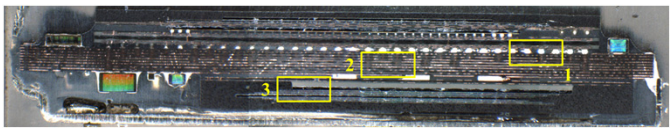


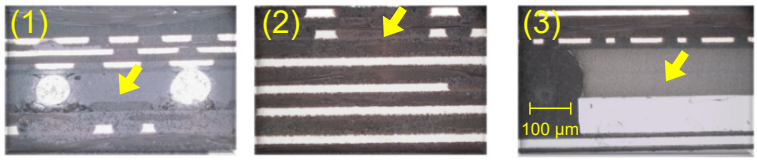
A commercially available smartphone was disassembled, and the removed substrate was cut near the CPU package. One of the two cut boards was placed in an oven and heat-treated at 150℃ for 7 days. The cross section of each specimen was polished to make the measurement surface.

<Untreated>



<After heat load test>



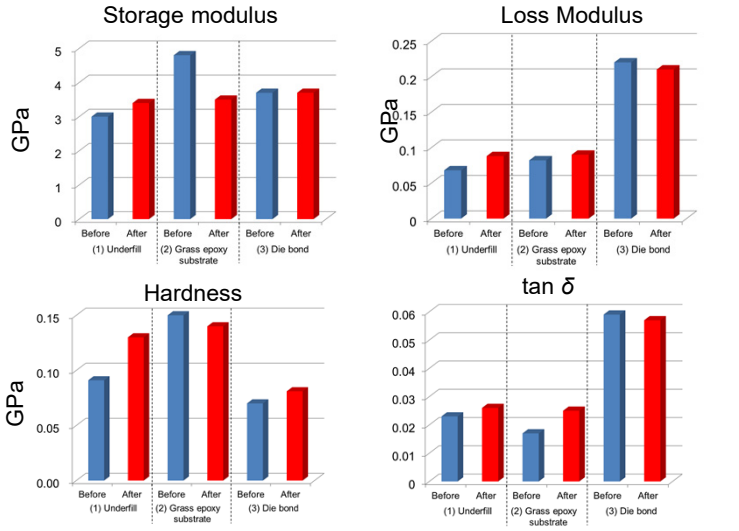


Underfill between solder balls

Resin part of grass epoxy substrate

Die bond film of flash memory under chip

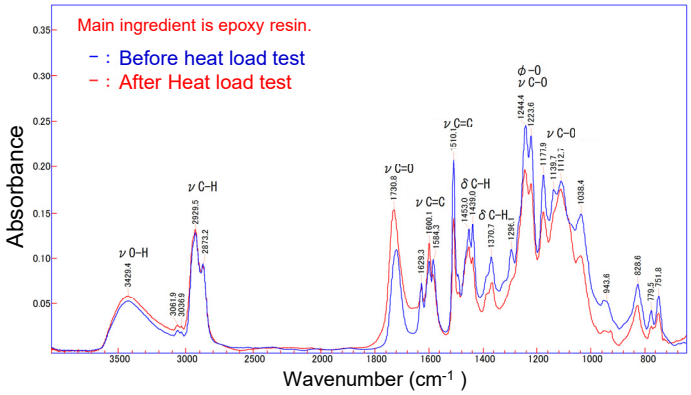
Mechanical properties by nanoindentation method



(1) In the underfill, the modulus and hardness increased slightly after the heat load test.
(2) In the resin part of grass epoxy substrate , the modulus and hardness decreased.
(3) In the die bond film, the modulus did not change, but the hardness increased slightly.

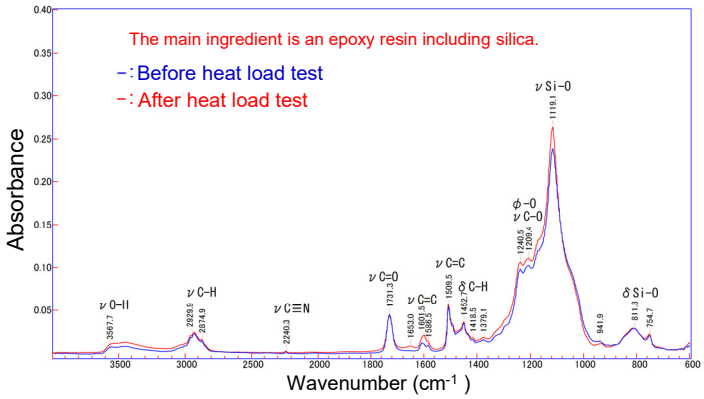
Infrared spectroscopy (FT-IR)

(1) Underfill



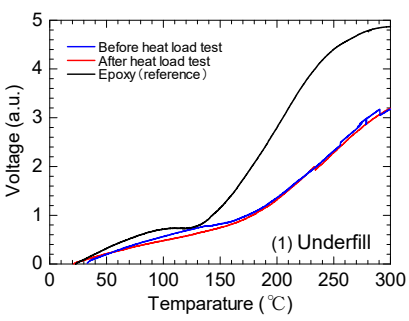
The increase of OH groups, C=O groups, C=C bonds, and carboxylates by heat load test indicates thermal degradation (oxidation or decomposition).

(3) Die bond film of flash memory



The increase of OH groups, C=O groups, C=C bonds, and carboxylates by heat treatment indicates thermal degradation (oxidation and decomposition) similar to that of underfill.

Thermal property measurement by NanoTA



Since there was no change in behavior before and after heat load test, it is considered that there are no residual uncured components.

For reference, the epoxy resin showed a step due to glass transition around 100 ℃.

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