Optimization for stress simulation in electronic packaging using Raman spectroscopy

Although the finite element method (FEM) is widely used for the full three-dimensional stress analysis in electronic packages, its numerical solutions strongly depend on the chosen model. The feedback using Raman spectroscopy can optimize the simulation model for stress analysis.

Problems of FEM and case studies of Raman measurements

Raman spectroscopy can provide the solution.

■ Problems of FEM

- Are numerical solutions reliable?
- Dose the model describe the real device correctly?

■ Advantages of stress measurements by Toray research center.

- Precise stress measurements in semiconductor. (Within ± several MPa)
- Theoretical backgrounds of Raman scattering.

【Case studies of Raman measurements】

- Introducing new structure for devices
- Adopting new materials for devices
- Introducing new process

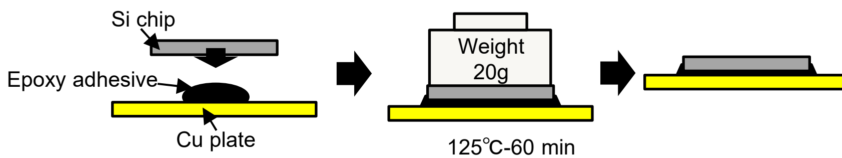
→ Stress variation can be quantitatively evaluated by the comparing the conventional structure, materials or process with the new one.

- Estimation of potential defects → Stress concentration can be identified by stress map or temperature-dependent stress measurement.
- After thermal cycling or power cycling tests → Positions where the stress variation are large can be identified by cycling tests.

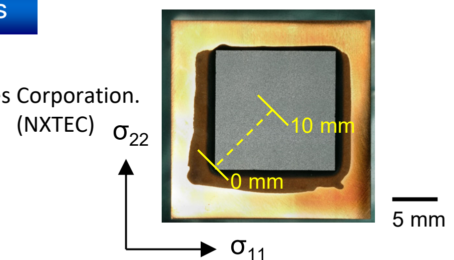
Case study: stress evaluation of Si chip after die-attach process

■ Si chip was mounted on the Cu plate with the epoxy underfill.

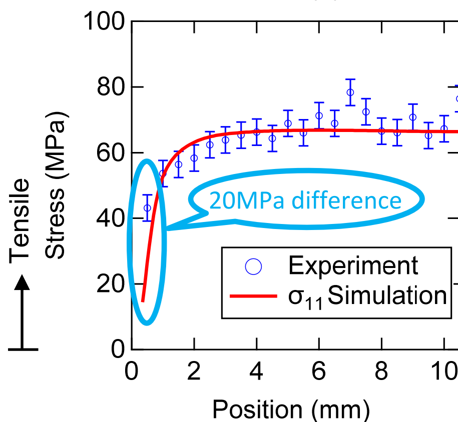
*Sample preparation and simulation were performed by NTT Electronics Cross Technologies Corporation. (NXTEC)



(a) Process of sample preparation.

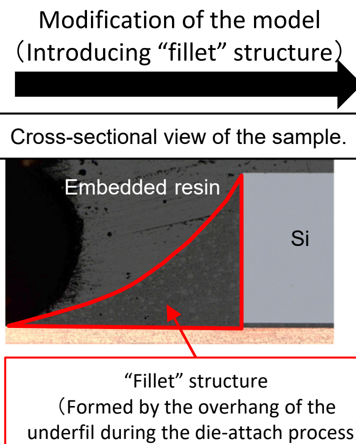


(b) Microscopic image of the sample.

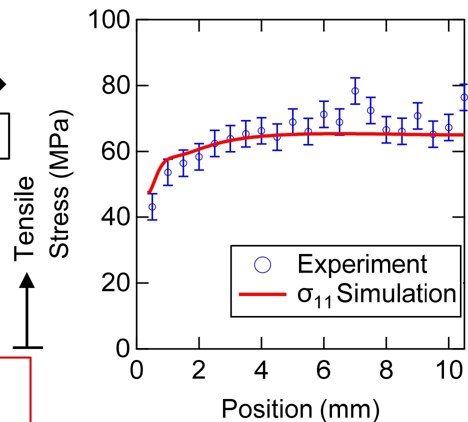


(a) Before introducing "fillet" structure.

Modification of the model (Introducing "fillet" structure)



"Fillet" structure (Formed by the overhang of the underfil during the die-attach process)



(b) After introducing "fillet" structure.

The difference between the simulated results and the Raman results became large in the vicinity of the chip.
⇒It's estimated that the FEM model near the edge of the chip cause this difference.

The FEM results was in good agreement with the Raman results near the edge of the chip by introducing the "fillet" structure into the simulation model.
⇒Raman spectroscopy can verify the validity of the FEM model.

Raman spectroscopy can optimize the simulation model for stress analysis.

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