Idea Stage Project
Reliability Evaluation using Mechanical Fatigue Test

Hironori Ohta, NEC

Background

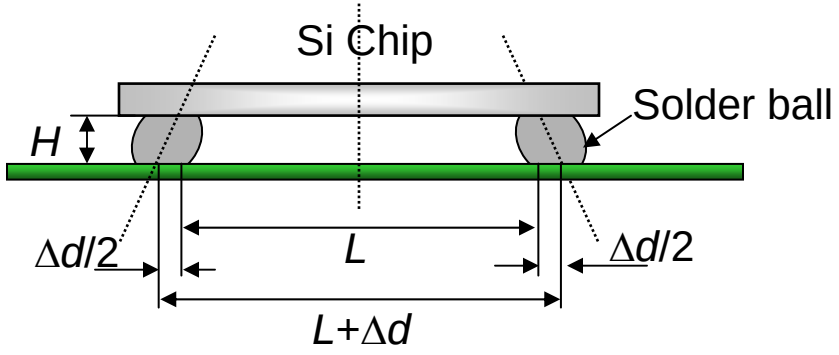
- Requirement for shorten an environmental test time - Need of a new method that can evaluate the reliability of solder joint in the short time
- Proposal on the solder joint reliability test using the mechanical fatigue test from universities and an organization – which has been proposed to IEC standards

Mechanical Fatigue Test

- The methodology is the imposition of shear deformation on the solder joints by mechanical displacement instead of relative displacement generated by CTE (coefficient of thermal expansion) mismatch
- In place of temperature cycle test, this imposition test is applicable to predict the reliability of the solder joints under repeated temperature change conditions by mechanically cycling the solder joints
- There are two test methods
  - Split board fatigue test
  - Single joint fatigue test

Split Board Fatigue Test

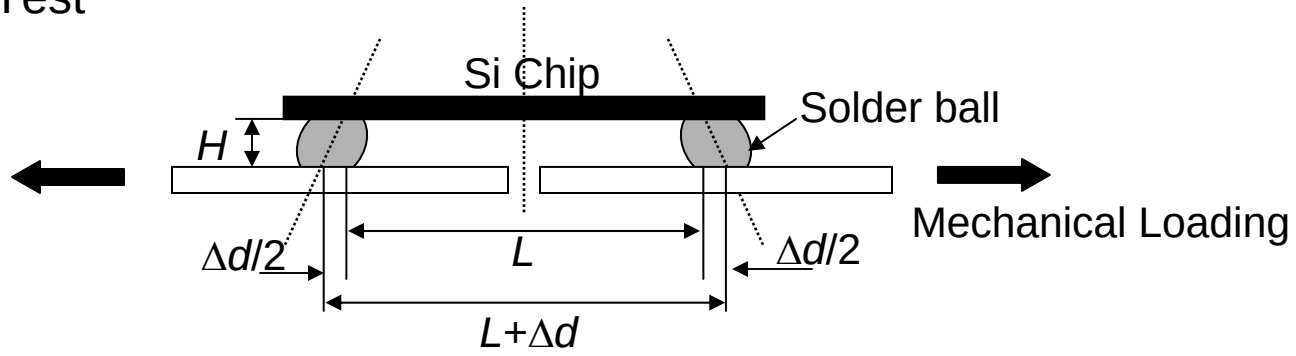
•Thermal Fatigue



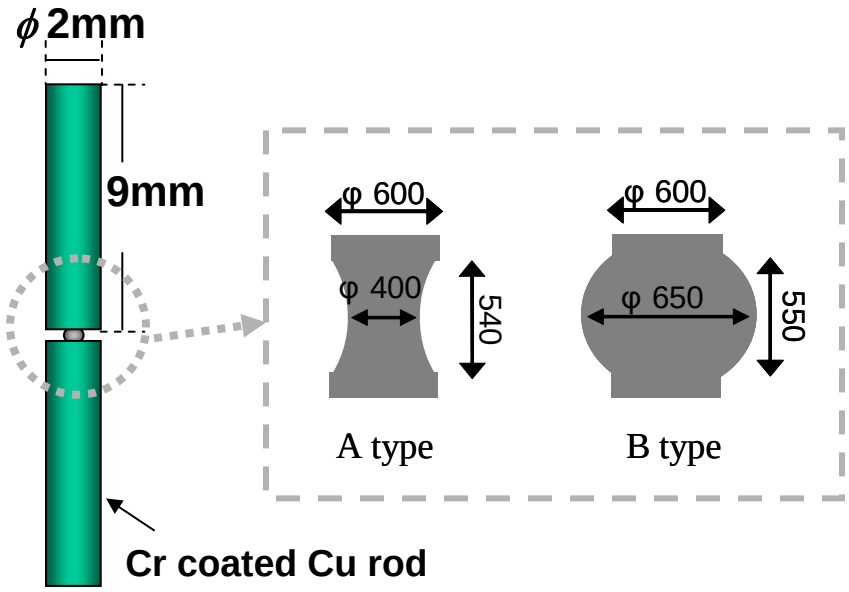
$$\Delta d = L \cdot (\alpha_{substrate} - \alpha_{chip}) \cdot \Delta T$$

α:coefficient of thermal expansion

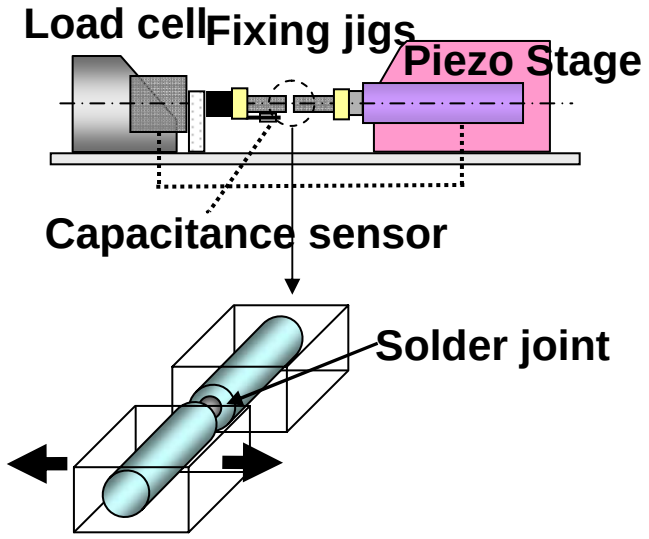
•Split Board Test



Single Joint Fatigue Test



Test Specimen

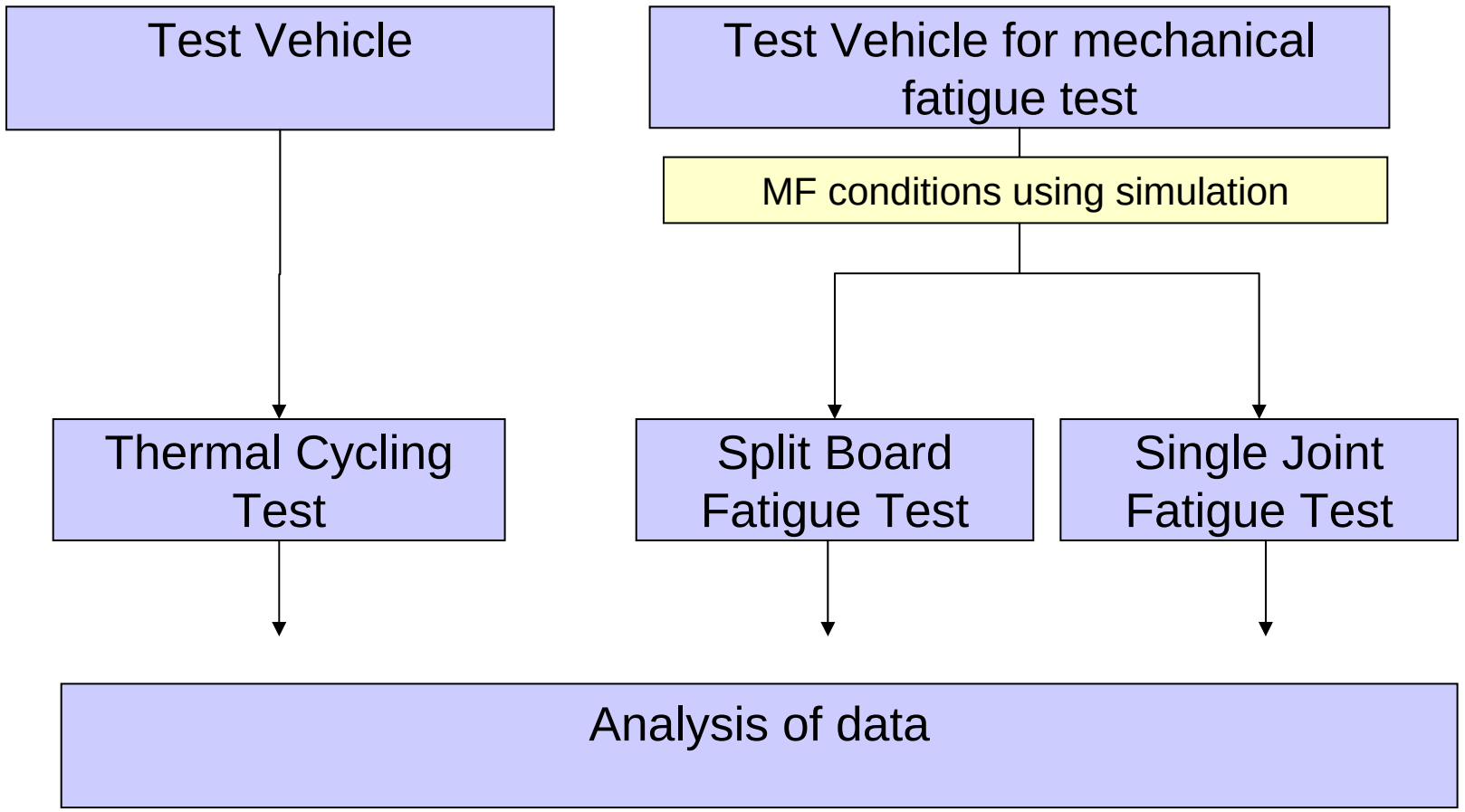


Test Apparatus

Purpose

- Study on practicality and its issues of mechanical fatigue test as a solder joint reliability test
  - Correlation of the reliability data between mechanical fatigue test and thermal cycling test
  - Finding the package and solder joint conditions where mechanical fatigue test can be used as the reliability test

Procedure


Test Vehicle
Test Vehicle for mechanical fatigue test
MF conditions using simulation
Thermal Cycling Test
Split Board Fatigue Test
Single Joint Fatigue Test
Analysis of data

Deliverable

- Report
  - Correlation the reliability data between mechanical fatigue test and ACT test
  - Finding the package and solder joint conditions where mechanical fatigue test can be used as the reliability test
- Paper
  - Presentation on a conference

Team Member

- Hironori Ohta (NEC) - Leader
- TBA (Fujitsu)
- TBA (Hitachi)
- TBA (Nihon Superior) – Providing solder material

- Package
- PWB fabricator
- Thermal cycle test
- Mechanical fatigue test – Prof. Yoshiharu Kariya (Shibaura Institute of Technology)

- Expecting Toshiba, Oki participate

Schedule

Project Task		Orig.	Actual	Current Outlook
Project Plan		07/07		
Test Board Assembly		10/07		
Test Specimen		11/07		
Thermal Test		03/08		
Mechanical Test		03/08		
Analysis		06/08		
Final Report		10/08		

Discussion

- Is it possible for Mild Acceleration Project to provide some test vehicles – If yes, we can reduce the cost (of packages and PWB procurement, thermal cycling test) and workload.
- Next meeting May 8 at NEC office
- Discussion items
  - Thermal cycle condition
  - Package
    - BGA (High Strain), CSP (Low Strain)
    - Ball diameter > 0 . 5mm - Due to the limitation of sample production for mechanical fatigue test
  - PWB
    - Better to have a split under the package for mechanical fatigue test