Thermal Cycling and Vibration Studies

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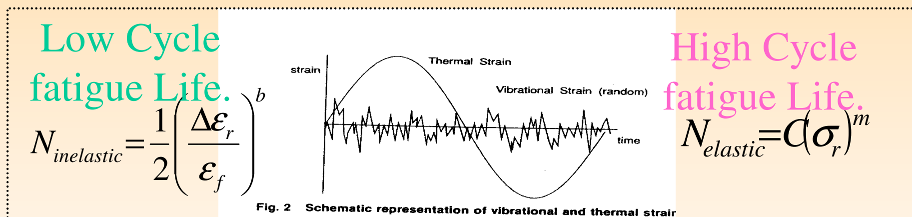
OBJECTIVES

- To understand the effects of combined low cycle (thermal cycling) and high cycle (vibrations) fatigue on solder joint life.
- **To develop a Finite Element Model to model an electronic package under combined thermal and vibration loadings.**
- **To develop solder joint fatigue life prediction models under combined thermal, vibration, and shock loadings environments**.

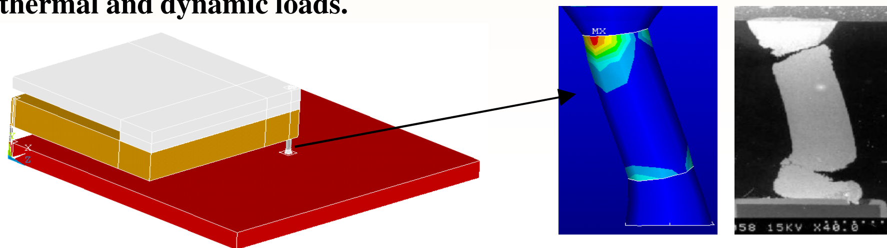


APPROACH

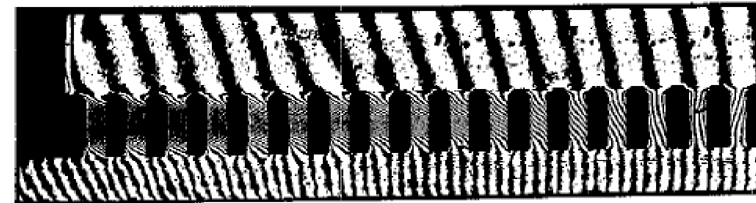
- Create a FEM model of a CCGA package using plate and beam elements.
- Validate thermal-mechanical behavior of FEM model using Laser Moire to obtain displacement and strain fields.
- Validate dynamic behavior of FEM model using modal analysis to obtain natural frequencies and mode shapes of a CCGA package.
- Assess solder joint fatigue life under various combined thermal and vibration environments using a vibration shaker in a thermal chamber.

ACCOMPLISHMENTS

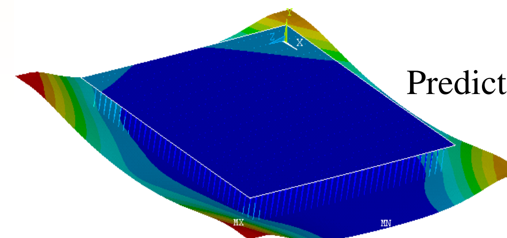
- Developed a 3D quarter model of a CCGA for predicting thermal-mechanical behavior. Predicted failure site validated against failures seen in ATC tests.
- ATC (0° to 100° C) tests of CCGA components has passed 2000 cycles with no failures.
- **Developed a 3D model of a CCGA for predicting combined thermal and dynamic loads.**



Maximum Inelastic strain from FEM shows correct failure site and mechanism.



Laser Moire Image of U displacement field induced by isothermal loading of $\Delta T = -60\ ^oC$. (B. Han, 1997)



Predicted Mode shape of CCGA from FEM.

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