Thermo-mechanical Analysis And Fatigue Life Prediction Of MCM-D Interconnects

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A thermo-mechanical analysis has been performed to predict the stresses within the interconnect structure of an MCM-D substrate induced by temperature cycling. The fatigue life of the via was then estimated, and trade studies were performed to assess the sensitivity of the prediction methodology to various key parameters. In this case, an MCM-D structure, implementing aluminum-silicon (Al-Si) metallization layers separated with a silicon dioxide (SiO_2) interlayer dielectric, was examined using a two-dimensional, plane-strain finite element model (FEM).

The model was used to simulate temperature cycling. The resulting non-linear, elasto-plastic stress-strain response was obtained, under the von Mises yield criterion, using both MSC/NASTRAN and P3/Advanced FEA. The strain-based fatigue life can be estimated from the finite element results using a Coffin-Manson relationship. Key material fatigue parameters were obtained from the available literature. The model was used to study the effect of various parameters such as metallization thickness, via wall slope, metallization material, and others on the predicted fatigue life. The results have been compared to available test results from the AI<PA-sponsored REI.TEC31 program.

The research described in this paper was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the. National Aeronautics and Space Administration.